Conceptual Infrastructure Master Plan 1994

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Tumen River Area Development Issues

REPORT c

Conceptual Infrastructure Master Plan

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BACKGROUND
The Tumen River Economic Development Area (TREDA) project is coordinated and supported
by the United Nations Development Programme (UNDP) on behalf of the five countries that
are signatories to the October 1991 Tumen River Area Development Programme (TRADP)
agreement: South Korea, North Korea, China, Russia and Mongolia. The project is expected to
improve the concentration of industry, level of employment and standard of living for people
living in TREDA and to create additional business activity in other regions beyond the borders
of the defined zone.
TREDA basically consists of that terrain located within conceptual boundary lines drawn from
Chongjin in the Democratic People's Republic of Korea, through Yanji in the

People's Republic
of China, to Nakhodka in the Russian Federation. It specifically incorporates Rajin/Sonbong
Special Economic Zone in the Democratic People's Republic of Korea; the Yanbian
Autonomous Prefecture in the People's Republic of China, which includes the Special
Economic Zones of Yanji and Hunchun; and Vladivostok and the Free Economic Zone of
Nakhodka including Vostochny, and Primorsky Krai towns and ports south of those cities, in
the Russian Federation.
A map highlighting TREDA can be found after the Preface of this Collected Papers publication.
With rapid economic expansion, the current TREDA population of 3 million is expected to
exceed 10 million by 2020 while the real average annual GDP per capita of this population is
expected to rise by a factor of more than 5.0, from approximately 1200 US dollars in 1990 to
some 6500 US dollars in 2020, in constant 1990 dollars. This will result in a significant
increase in the demand for effective transport to, from and within the region. Consumption of
electrical energy and clean water will also increase in proportion to industrial development and
population growth.
A convenient, reliable, safe and cost-effective road, rail, air and seaport transportation
infrastructure along with water, waste treatment and electrical energy will act as catalysts to
facilitate trade and spur population growth and industrial development. Providing adequate
utilities and improving transportation infrastructure for all modes to provide convenient freight
distribution and travel links worldwide is a precondition to help transform TREDA into a major
international shipping, trading and manufacturing zone with a favourable investment climate.
Such a climate will help attract potential foreign investors and accelerate economic growth and
prosperity.
There are two major interdependent issues, industries and infrastructure, which are the key
components for development.
Many people are currently employed in small and light industry within TREDA, but industrial
growth will not be possible without establishing an appropriate infrastructure capable of
supporting the full amount of industry that the region's population and skills can develop. The

elements of this infrastructure include telecommunications, air transport, road transport, railways, ports, electric power and water, accommodation and food. In addition, support services such as printing, banking and industrial supplies are a necessary part of the industrial segment of the development. Consulting engineering, accounting, legal services and other service industries must also be a part of this growth.

This report discusses the railway, seaport, highway, airport, water and electrical energy developments needed to facilitate the industrial growth expected in the area. As the existing facilities, in most cases, are inadequate to serve a large industrial growth, improvements are necessary to permit it. For each of these infrastructure sectors, the report will outline the objectives, describe and appraise the current situation, summarize our observations, make recommendations and provide an implementation plan for improvements.

A companion UNDP sponsored report "A Regional Development Strategy for the Tumen River Economic Development Area" recommends "the strategy that seems most likely to accelerate development of the region taking into account both the objectives of the participating Governments and the likely interests of foreign investors." This report, a "Conceptual Infrastructure Master Plan" should be read in conjunction with it.

The information included in this report is based on visits, interviews, and/or inspections in the Russian Primorsky Krai region and in Jilin Province of China. The CPCS infrastructure team travelled the roads, toured power plants and airports and saw railway track and facilities.

Information about the Democratic Peoples' Republic of Korea (DPRK) infrastructure and the ports of Rajin and Chongjin came from reports, earlier studies and meetings with port and railway officials, especially representatives of Northeastern Asia Railway and Port Group Company Ltd., Jilin.

Interviews with government officials, town planning representatives and port and civic officials were supplemented by meetings with staff at China Ocean Shipping Co. (COSCO) and former officers of Russian Far East Shipping Co. (FESCO). Members of the mission representing Russia, China and South Korea also provided valuable information.

The Ministry for External Economic Relations of the Russian Federation submitted extensive

constructive comments regarding the Interim Report. Where applicable, these have been
incorporated in the Final Report.
Finally, CPCS Ltd. has drawn on its own experience on rail, highway and port economics and
operations, and on intermodal transport. Port information also came from established trade
publications such as UK Lloyd's List, Fairplay, the IMO (UN-International Maritime
Organization) Data Bank, Containerization International, and others published in Asia, the USA
and Switzerland. CPCS Ltd.'s associate consultants, Monenco-AGRA contributed to the report
preparation for the Water Supply and Waste Water Treatment and Electrical Power Sections.
Airport Planning Associates (APA) contributed to the Air Transport Network Section, and much
of their information came from the International Civil Aviation Organization in Montreal, Canada
(ICAO), from the National delegation offices of China and Russia at ICAO, from the
International Air Transport Association in Montreal (IATA) and from published airline
timetables. CPCS' sub-consultant and associate for the railway and highway infrastructure in
China is the China Academy of Railway Sciences in Beijing and its affiliated consulting
company the Zhong Tie Science and Technology Development Corporation.

REPORT SUMMARY

GENERAL

The three Tumen River Economic Development Area (TREDA) riparian countries along with
Mongolia are all in the process of economic reform, moving towards a more competitive,
market-oriented economy similar to the Republic of Korea (ROK). Future success depends on
cost-effective transportation infrastructure, water and electrical energy in support of
development efforts.
The existing TREDA infrastructure, the plans for future expansion and improvements and the
opportunities (i.e. gaps to be filled and barriers to be overcome) to accommodate anticipated
industrial development are documented here. This report will:

- assess short and medium term needs and recommend a plan for infrastructure items to
complement existing facilities to satisfy initial levels of economic development;

provide an implementation plan framework;
assess long term needs of infrastructure items; and
assess the potential and methodology for international financing.

The following is a brief summary of the Infrastructure Conceptual Plan with a focus on the priority areas for the short to medium term needs.

The Infrastructure Team has used existing documents rather than obtaining first-hand knowledge of transport in the Democratic People's Republic of Korea (DPRK).

SEA PORTS

The key ports of Zarubino and Rajin could be in immediate operation for TREDA exports and imports if already agreed truck/rail connections are completed, and if relatively simple institutional arrangements are made. An essential ingredient in this will be the development of inland container depots (ICDs), already beginning to be built.

Lead times for port improvements are long (planning, finance, design, construction) and, thus efforts should quickly begin for the creation of two or more containership berths in each of Zarubino and Rajin ports to handle PANAMAX ships. Each berth should be equipped with two PACECO type container cranes and have 13.2 m of water depth alongside.

Three required institutional changes would bring TREDA ports in line with standard, worldwide practices for the handling of general cargo in containers, or on vehicles in roll-on, roll-off (ro-ro) operations. First, there must be firm agreements for the passage of sealed containers (or trucks) through transit nations, mainly Russia and DPRK in this case. Such agreements are common worldwide including in Russia and CIS nations. Second, there must initially be external expert management of the containership berths. Generally, these experts (P. and O. for example) phase out in favour of national management in about three years. Lastly, there must be an understanding that vessels are permitted to use their own on-board cranes for handling containers.

Bulk cargo terminals do not present an immediate problem, mainly because they tend to be planned, financed, and managed by joint venture partners. These are usually the owners or shippers of the cargoes, for example Alcoa and Siberian steel producers. Furthermore, all earlier reports indicate that there is ample room for expansion or relocation in existing terminals.

In Russia, the ports of Vladivostok, Nakhodka, and Vostochny are all

available but may not be
quite as useful for TREDA shippers as Zarubino will be. Vostochny gives priority to its essential
role as the Trans Siberian Railway (TSR) Eastern terminal, and Nakhodka gives priority to
regional trades. Vladivostok is an inner city port where expansion possibilities are limited.
In DPRK, geographic position and physical assets make Rajin an excellent port for TREDA.
However, Chongjin is closer to shippers south of Yanji (Helong for example) and should thus
be considered for some development.
The need for an accelerated transition to container operations should be emphasized, because
the entire East Asian system is already containerized, and TREDA cannot stand alone.
Furthermore, while sealed containers can pass through customs barriers, loose general
cargoes present entirely different problems. It follows that there must be immediate emphasis
on development of ICDs. This is well understood by the China Ocean Shipping Company
(COSCO) and by outside forwarders.
Finally, there are many low cost interim approaches that will facilitate export/import
movements, for example ro-ro shipping, and the use of air freight. These tend to enable
operations to begin, even though they may later be replaced by more sophisticated systems.

RAILWAY TRANSPORT NETWORK

The missing railway links between Hunchun and Zarubino and Hunchun and Rajin must be
completed as an urgent priority to give the ports of Zarubino and Rajin the critical
transportation connection with the rest of TREDA.
Standard gauge should be provided as soon as possible between Zarubino and Hunchun to
facilitate the movement of goods between the port and points west of Hunchun. This would
imply adding standard gauge track between Hunchun and Zarubino, probably making it a
composite track, and would eliminate the need to use the gauge change facility at Hunchun
with its attendant costs and shipping delays. The gauge change facility would then be
dedicated to commodity exchange between Russia and China.
Financial feasibility studies using the recognized format of International Development Banking
should be carried out as soon as possible to evaluate the investment necessary for the design
and construction of the marshalling yard and the international passenger

terminal at Hunchun.
Market demand and traffic forecast studies should be undertaken in order that the railway can
plan and manage its network in an efficient and effective manner.
By reviewing all operating alternatives, including modernizing signal systems, extending
sidings, increasing axle loadings and changing from steam to diesel locomotives, significant
traffic growth can be accommodated before major capital investments in plant capacity will be
required.
Modern electronic management information systems should be introduced to the system both
in TREDA and to the adjacent railway interfaces to effectively monitor and control the
movements of shipments.
Roadrailers offer an interesting possibility for commodities that demand overnight or twenty-
four hour origin to destination delivery.
A careful examination of the need for passenger trains over the short distances within TREDA
should be undertaken before extensive passenger service is introduced.
HIGHWAY TRANSPORT NETWORK
The TREDA highways should be considered as a total system network to ensure efficient,
distribution of freight as well as convenient passenger travel. Standards covering highway
classification systems, equipment dimensions and maximum weights, should be harmonized to
provide uniform rules to avoid conflicts with cross border truck transportation.
Efforts must be continued in conjunction with bodies such as the UN's Economic and Social
Commission for Asia and the Pacific (ESCAP) to encourage international agreements to
facilitate cross-border traffic.
Current highway construction should be completed in the near future to provide for the short
haul traffic which is most suited to the highway mode. Special consideration should be given to
the improvement of road passenger transport from the three major airports at Chongjin, Yanji
and Artem (Vladivostok) to other TREDA centres, and the desire to handle fully loaded
transport trucks to roll-on roll-off (ro-ro) facilities at many of the seaports.
Complete reconstruction of those highway sections which form the basic network, and are not
up to standard, must be carried out in the near future.
Bypasses of major urban areas must be provided in order to retain a reasonable transit time

for freight and passengers.
In areas where there are long and often steep inclines, truck passing lanes should be built in order to prevent long lineups and delays from occurring and to provide greater safety.
The inter-city highways must be maintained in good condition during all seasons to provide reliable conditions for all traffic, and therefore staff and equipment must be put in place for snow plowing, salting and sanding in winter, and pavement maintenance in summer.
Truck weigh scales must be installed and enforcement mechanisms should be implemented to monitor load weights to prevent highway damage.
Careful consideration must given to the cost of trucking non-time sensitive commodities. The highway should not be allowed to become congested with heavy bulk loaded trucks that could easily be handled by rail.
Traffic growth should be continuously monitored and highway capacity should be increased when justified by demand.

AIR TRANSPORT NETWORK

Safe, secure, cost-effective and convenient air travel for persons and high-valued, time-sensitive goods are essential for economic, industrial and social development. In the context of TREDA, the achievement of this objective will involve optimizing the use of existing airport and aeronautical facilities as well as planning for the development of any new facilities that may be required to support improved air service in the region.
At present, there are three airports within TREDA providing civil aviation services: Vladivostok (Russia), Yanji (China) and Chongjin (DPRK), located at the apexes of the triangular area forming TREDA. Due to their peripheral locations, these airports essentially serve tributary regions within their own respective national territories, leaving the central area of TREDA (around the Tumen River estuary and the adjacent Russian and DPRK coastline) without adequate ground connections to air service. The closest airport to this area, Yanji, is still almost two hours by road from the Chinese city of Hunchun, while Vladivostok and Chongjin are some five to six hours from the Russian centres of Zarubino and Kraskino and the DPRK centres of Rajin and Sonbong respectively.
With respect to airport facilities, the Vladivostok airport (located some 50 km northeast of the

city at Artem) has runways and navigation aids capable of accommodating the largest wide-
body jets on inter-continental flights, but the level of service in the passenger terminal building
is very low, especially with respect to passenger handling and immigration/customs clearance
inspections and procedures. The airport at Yanji has recently been upgraded by an extension
of the runway, enabling it to accommodate medium-sized jets on regional flights, and new
passenger terminal facilities, navigation aids and air traffic control installations are being
constructed. Chongjin is a relatively small airport, with facilities capable of accommodating
local turbo-prop flights during daylight hours and in good weather.

The major impediment to improvement of air transport between TREDA and the rest of the
world is that there are severe restrictions on flight paths due to many no-fly zones near the
immediate region. The TRADP countries should establish a priority to remove these flying
restrictions which will then permit greatly reduced flying time and cost for passenger travel and
shipment of freight in and out of the TREDA region. This process is also necessary to enable
airlines of the TREDA countries as well as foreign airlines to respond to the air transport
market in TREDA and, as the market grows, to justify the opening of new bi-lateral air
agreements for foreign airlines to serve TREDA.

Thus, while it is possible for passengers and freight to move in and out of TREDA via the
existing airports of Yanji and Vladivostok, the ground travel time to Vladivostok is too long for
business travellers or high priority freight. Upgrading of the roads connecting the centre of
TREDA to Yanji and to Vladivostok will help in the short run but for the longer term, a new
airport chosen in a location to best support the industrial growth of the area will be needed. For
this reason, a feasibility study for the best location, operating requirements and construction
timing for a new airport should be undertaken. The Yanji Airport and its new terminal buildings
presently under construction will serve TRADP adequately for the beginning of industrial
growth, although not sufficiently well for the long term.

WATER SUPPLY AND WASTE WATER TREATMENT

With the anticipated population increase from 3 million to 10 million and the great growth in
industries, tourism and other service sectors the provision of water and the

treatment of waste
water will become critical to TREDA's ability to satisfy the demands of the area.
Comprehensive planning of the need for water and waste water facilities must be carried out
now to develop a strategy on how best to meet the developing needs. It will be necessary for
the TREDA countries to decide whether facilities should be planned on an area wide basis or
locally.
In the first case, UNDP could undertake to coordinate the regional planning process or help set
up a planning commission. In either case, they could take the responsibility of supplying the
three governments or the planning commission with:

- population and industrial growth projections;
- future per capita water demand;
- waste water requirement statistics; and
- costs.

ELECTRICAL POWER
Economic development relies greatly upon the availability of electrical power, and therefore
there is an urgent need to identify economically feasible new sources of electricity to support
TREDA.
Comprehensive studies must be undertaken to develop area wide demand and energy
generation requirements. This, by necessity, must be based upon both residential and
industrial growth forecasts, which can be passed on to the appropriate electrical planning
authorities by the UNDP.
Currently most power is supplied by coal-fired thermal generation which is adding considerably
to air pollution in TREDA. New coal-fired plants will presumably be built to be environmentally
friendly; it follows than that the cost of such plants should be used when making comparisons
with the cost of using hydroelectric power. Harnessing hydroelectric potential in rivers outside
TREDA, but contiguous to it, should be included in this comparison.
Planning authorities should keep in mind the possibility of exporting or importing power across
national borders, or inter-connecting grids for reliability and load levelling purposes. Where
differences in national frequency standards exist (DPRK - 60 hertz, Russia and China -
50 hertz), obstacles to these possibilities are greater, but can be overcome by using
rectification and frequency conversion equipment.

SEA PORTS

OBJECTIVES

The three riparian countries have each created Free Economic Zones. In Russia and the DPRK these zones are centred on seaports at Nakhodka-Vostochny in Russia and Rajin-Sonbong in the DPRK. China's zone has been created at Hunchun but its success is largely dependent on access to a seaport at either Rajin-Sonbong or Zarubino in Russia, or to both.

This report will:

- identify barriers in the port system and provide a strategy to remove them;
- provide a brief description of the present and future local and world shipping systems, and their implications to this region, and a discussion of the operating and management systems of each TREDA port;
- identify required infrastructure improvements for the medium and long term and the appropriate arrangements for financing.

EXISTING SITUATION

General

Earlier reports have described the TREDA ports, and Vostochny has published a descriptive brochure. Therefore the following is a brief summary of the most important features of each port.

MAP 2.1

Institutional situations and their benefits and problems are also discussed. A list of projects in the planning or pre-planning stages is included in Appendix C.

Russia

Vostochny This is a modern well designed port capable of handling over 300,000 containers a year, in addition to bulk oil, coal and ores and large break- bulks such as timber. There is ample room for expansion of the bulk and other terminals, but unwise construction of housing and administration buildings may have limited increased container movements. Personal observations (and the brochure) show the existing yard completely filled with containers. The container terminal was designed primarily to serve the Trans Siberian Railway (TSR), and each of the three berths are served by two modern Paceco type cranes. A sophisticated AMS (computer controlled Automatic Management System) does not appear to function well.

Maximum allowable draft is 13 m which is adequate for handling any containership now operating. There are expansion plans for all facilities.

Movement of containers from the Trans Siberian Railway (TSR) began in 1976, and Vostochny has ever since been seen as the primary Eastern Pacific Basin outlet for the TSR. Most recent port improvements have been financed by joint venture agreements. It is apparent from discussions and literature that TSR business has preference over others in the general cargo container facilities. They state that coal exporters have in joint ventures financed development of the excellent coal terminal there. Here and throughout the study area it appears that joint ventures work well in creating port terminals for bulk (coal, oil, ores, grain etc.) and large break-bulk (timber, cars, steel, paper, scrap, etc.) cargoes. The problem lies in creating similarly workable arrangements for general cargoes whose owners are diverse.

Sea-Land, a USA ship line owned by the CSX rail group, has been a major user, also the owner of 3,400 flatcars on the TSR system. They announced on April 6, 1994 that they are seeking a new joint venture agreement which may lead to hard currency investment in new facilities. At the same time Sea-Land announced a 30 million US dollar investment in the Port of St. Petersburgh at the western end of the TSR.

While trans Pacific ship lines have served Vostochny by transhipping (in Japan and ROK) to feeders, the Far East Shipping Company (FESCO) will from April 20, 1994 offer direct sailing linking the Russian ports of Vladivostok, Vanino, and Magadan with the US ports of Los Angeles and Seattle. Following this example if the Trans Siberian Railway services are upgraded, this could lead another line (Sea-Land or Hyundai) to serve Vostochny direct.

This port does not seem to be an important factor in TREDA shipping. Road/rail connections are difficult, there are Customs problems, and the management seems to favour TSR and local Primorsky Krai business. Shippers complain that the container tracing/locating system does not work.

Nakhodka This is a typical inner city port which seems to function well because nearby Vostochny has taken away expansion pressures. Being relieved from TSR business, it can cater to regional needs and some overflow business from Vladivostok and

Vostochny. Its general cargo berths are served by many old fashioned European style cranes. There are two passenger berths, a separate oil terminal, a ship repair yard, and many berths for bulk and neo bulk ships. Two million tons of general cargo are handled in an average year, almost all in break bulk (not container) form. Depths alongside are 9.7 m, which is adequate for most vessels operating in the East Sea (Sea of Japan). There are plans for modernizing some berths and providing depths of as much as 13 m alongside.

Handling about the same volumes as Vostochny, this port seeks added business through promotion of a Free Economic Zone. It seems clear that the combination of these two good ports will absorb not only TSR business, but also many Primorsky Krai cargo movements now being handled in Vladivostok. The Free Zone programme is largely in the planning stage.

Nakhodka could take some TREDA overflow business, but as with all Russian ports, there are customs and road/rail connection problems.

Vladivostok Formerly devoted to Russian naval operations, almost all of its 16 berths totalling 3,705 m have been privatized. There is a new container berth (280 m) with two Paceco type cranes and about 10 m water depth alongside. A limited storage area can hold about 5,500 twenty foot equivalent units (TEUs). There are extensive ship repair facilities, local roll on-roll off (ro-ro) berths, and at Golden Horn Bay there is a passenger ship terminal with a quay 414 m long. Most berths are served by extremely old cranes maintained by cannibalizing parts from other cranes that have been discarded. These berths are supported by nearby transit sheds which make container handling almost impossible. This is an inner city port which can serve well in the short term, but not be expanded in the immediate area. Lack of expansion space, environmental considerations, inner city costs, and normal non maritime growth (housing, recreation etc.) will compete for scarce space as has happened in cities such as Bangkok, New York, Manila, Jakarta and San Francisco. Satellite ports nearby could provide some expansion possibilities, but are not currently being considered.

It is understood that the firm Price Waterhouse is making a study of the Port of Vladivostok.

Shipowners report that, though privatized, Vladivostok is a difficult port,

with many hidden
costs and difficult working conditions. Though somewhat closer than Nakhodka-Vostochny,
this presents the same problems of truck/rail connections and customs procedures. As a short
term overflow facility Vladivostok may be useful to the Tumen area, though not a serious factor
in long term plans.
The new FESCO direct USA service should give the port a short term boost. FESCO is said to
have preferred status and special influence in Vladivostok, their long established
headquarters.
Slavyanka Local authorities indicate that there is adequate space, protection and water depth
for a large scale port operation, but that other activities are preferred, mainly ship repair and
fishing. Jeuro Container Transport, a major Japanese forwarding company attempted to
inaugurate a ferry service linking Slavyanka with the Japanese ports of Niigata and Maizaru.
There does not appear to be any published data about this port, and it is not listed in any
international port directory.
There do not appear to be any plans for large scale commercial shipping here. However, it is
reported that physical conditions are suitable for a substantial port development. Efforts have
been made to set up a ro-ro link to Japan, and ro-ro shipping is a traditional device for
circumventing difficult conditions in conventional ports.
Zarubino This and Rajin in DPRK are likely to be the two most important marine terminals in
the future to Northeast Asia and TREDA economic plans. This is true because, as explained in
other parts of this report, road, rail, and customs problems make the use of other Russian
ports difficult. Severe rail system congestion hinders use of Chinese ports of Dalian and Tianjin
far to the south.
Nearby Posiet has equal geographic advantages, but has not been considered to any great
degree, being in a delicate environmental area. A large movement of export coal will be
transferred from Posiet to Vostochny. A passenger terminal may be built here in the future.
Zarubino, also known as Khasan Maritime Commercial Port, can now berth three
containerships on its 600 m berths with 9.5 m of water alongside. It is served by two old
cranes each with five ton limits. An adjacent terminal receives, stores and tranships fish

products. There are plans for expansion.
A report of Japan's Engineering Consulting Firms Assn. discusses an elaborate Zarubino
expansion plan involving 25 berths. However Zarubino port officials advised that design and
feasibility studies have not begun. It is clear that this is a port in which large scale expansion is
physically possible.
Port officials explain that Siberian steel exporters are important joint venture partners, and this
was evidenced by the amount of steel bars, angles, rails, etc. spread over the area, with a ship
being loaded with aged five ton cranes. In order to handle transit containers and general cargo
there will need to be, in the short term at least, outside expertise plus an understanding of the
placement of steel products. The cranes should be replaced by use of ship's gear in the short
term and eventual installation of Paceco type cranes, two to a berth.
While officials explained that detailed feasibility/engineering studies were in the future, they
also mentioned establishment of offices in Hong Kong, Singapore, Japan and elsewhere.
Earlier reports suggest that somewhat elaborate (though general) planning has taken place.
Work observed in road/rail connections to Hunchun supports this point. Note that Northeastern
Asia Railway and Port Group Company Ltd. insists that external professional port management
will be introduced for those berths devoted to TREDA and other northeastern Asia business.
There may be difficult conflicts with the joint venture partners who presently enjoy much
freedom in port operations.
While two of the three berths could now perform well using ship's gear, it will eventually (by
1998) be necessary to have two berths with shore container cranes and about 13.6 m depth of
water alongside and backup open space for boxes in transit.
DPRK
Rajin Like Zarubino, this DPRK port is well protected from open sea storms, and suitable for
expansion to over twenty deep water berths. As at Zarubino, some expansion planning has
been done. Presently there are three old style finger piers providing 2,515 m of berth space.
The Northeastern Asia Railway and Port Group Company Ltd. advises that one berth is
dedicated to storage and shipping of chemical fertilizer, and another for the import of Alcoa
alumina. The latter has modern sucker ship discharge devices. There are also

a ro-ro berth, a
berth devoted to scrap metal, and a number of open berths capable of handling general cargo.
Depths of water alongside are about 9 m, enough for vessels up to 10,000 dwt. There are
many old style 5 ton Russian designed cranes. It will be possible to gain much greater depths
at newly built berths.
According to The Northeastern Asia Railway and Port Group Company Ltd., Rajin is favoured
over Zarubino for coal and other bulks that may present environment problems. Plans for low
cost interim improvements, better road and rail connections, and a new silo for corn exports in
bulk are being prepared.
Data about DPRK ports comes from earlier reports, and it appears that bulk cargo interests
such as Alcoa are able to make suitable arrangements. Their ability to produce immediate hard
currency is probably a factor.
Here also there will need to be initial operating management assistance provided by an
outside group.
Chongjin Located within the large industrial city of Chongjin, this port could take pressure
away from Rajin. Its West Port is devoted to bulk cargoes such as grain, ores, coal, iron and
steel. The East Port is devoted to general cargo moving over eight berths capable of handling
ships up to 10,000 dwt. There is a composite gauge rail connection to the Russian system.
There is no evidence of large scale expansion plans such as those contemplated in Rajin and
Zarubino.

OBSERVATIONS AND COMMENTS

Earlier Reports

The observations on the present situation by earlier reports were accurate, but this report
questions their positions on the following four issues.

Port Specializing

The suggestion that either Zarubino or Rajin should be the key container port and that only
one should concentrate on break bulk general cargo is not realistic, and such an arrangement
could never be legislated. Port competition is essential. The two ports serve different
hinterlands. Break bulk general cargo movements will be limited. It is carriers (ship lines) that
usually decide what ports and cargoes are served.

Cargo Flow Forecasts

All reports admit that these are preliminary and based on extrapolations.

However, they seem
to ignore options available to shippers in TREDA, namely rail (Chinese and Russian) to the
West, rail to the Yellow Sea and air freight. As noted elsewhere in this report, most of these
options will be improved in the near future.

Ship Types

All reports suggest the need for extremely expensive berths to handle POST PANAMAX super
ships. With the possible exception of Vostochny, such vessels will not call at any TREDA port
before year 2000. As noted in the section "The East Asian and World Transport System", the
international container ship system is still evolving. It may be wrong to obstruct immediate
actions by concern over matters that can be decided later.

Degree of Containerization

Previous reports discuss the gradual transition to container operations, and the reports
suggest an expensive novel system for break bulk cargoes. This is questionable as the entire
East Asian system is now containerized, and there is no merit in resisting. The China Ocean
Shipping Company (COSCO) and FESCO have already conceded the point by establishing
Inland Container Depots (ICDs) and by ordering containerships. The only hope for avoiding
DPRK and Russian border problems lies in moving goods in sealed containers or trucks.
Furthermore, ships that carry break bulk (non container) cargoes are over aged and are not
being replaced.

The East Asian and World Transport System

Infrastructure decisions in the TREDA area must be made subject to the ships and shipping
systems which the ports will serve. Forecasting to year 2000 is not difficult as many of the
fundamentals are in place or planned. Much of the present or planned world fleet will still be
operating then, and port construction usually consumes six years or more for plans, finance,
design and construction.

Present Maritime System

TREDA maritime trade is primarily with Japan, ROK and Chinese Yellow Sea ports. This is
conducted with small vessels, generally under 20,000 dwt and able to call at all of the ports
mentioned above. Many of the vessels in this trade are old, and not able to be insured for
worldwide voyages. The dominant general cargo movements are between Pusan and
Vostochny. Much of this is transhipped to the TSR from long haul vessels

serving Pusan.
There is not presently enough container business to attract direct calls by vessels sailing from
Europe or the Americas. In addition to TSR business, ships of the Conflo Line and others carry
between Pusan and Vostochny substantial cargoes for the Russian Primorsky Krai area.
Shippers in Heilongiian and Jilin (China) are currently forced to use the heavily loaded rail
connections south to the port of Dalian and others on the China Yellow Sea coast. This is true
because truck and rail connections to TREDA ports of DPRK and Russia are difficult as are
customs procedures. Some intra Asia vessels call directly at Dalian. COSCO serves this trade
frequently, and they operate a major ICD in Harbin. They plan another ICD soon in
Changchun. Both will consolidate containers and general cargoes for movement by rail to
Dalian. This dominant Chinese line has no plans to serve any TREDA port.
Long haul ship lines avoid transhipment in Japan because the ports there are expensive (330
US Dollars/TEU) and slow. By comparison Pusan costs are moderate (160 US Dollars/TEU)
and their cranes are three times faster. This means that long haul PANAMAX size vessels
which cost about $30,000 US Dollars per day save time and money by transhipping at Pusan
which is only 815 km from Vostochny.
There is considerable direct trade between TREDA ports and Japan, much being in ro-ro
vessels which are able to use less developed ports and to avoid high Japanese handling
costs.
One serious, but solvable, obstacle is the general insistence that vessels use port shore
cranes which are slow and obsolete. East Sea (Sea of Japan) ports demand this in order to
maximize their revenues. However, geared vessels (vessels with on board cranes) are
available in the Asian (and world) markets at modest added cost. These can easily outperform
existing shore cranes, especially when handling containers.
It follows that, assuming on board cranes can be used, the existing port infrastructure is
adequate for any cargoes likely to move in the short term. The present obstacles are in the
road/rail connections and diplomatic/customs procedures.
For example four berths, two in Zarubino, and two in Rajin, could handle 400,000 TEUs (4
million tons) assuming 24 hour 360 day operations. The vessels in this trade

will generally
draw less that the 9 m that is available throughout the system.
Vostochny is the only TREDA port that can accept a PANAMAX ship drawing 13.2 m, but this
is not a problem. These large ships are engaged in long haul trades, generally round world
services. Due to their extremely high costs and delicate schedules they only call at load centre
hub ports such as Rotterdam, New York, Los Angeles, Hong Kong, Singapore, Colombo and
Dubai. Such ports offer over a million TEUs of business (ten million tons per annum), which is
more than is likely to move in the TREDA system even in year 2000. All lesser ports are served
by smaller feeder ships such as those that feed the entire ASEAN area from Singapore and
Hong Kong. The present TREDA port system can handle virtually all of the current feeder fleet.
Maritime Trade to the Year 2000
Bulk cargo ships carrying oil, ores, grain and coal are all fixed in design and operation. This is
true because they have grown to the limits of the ports and channels that they use. Except for
minor refinements, their low speed diesel engines and hull forms will not greatly change in the
foreseeable future.
The same cannot be said for containerships that will soon dominate general cargo movements
worldwide. PANAMAX ships in round-the-world trades are locked into the shape limits set by
the Panama Canal. Round-the-world carriers are not likely to ever call at TREDA ports as
these ports are too far away from the main line necessitating an expensive diversion and not
likely to offer enough cargo.
There are economies of scale in building POST PANAMAX ships which are too wide for the
Panama Canal. These can be faster, more seaworthy, and more efficient (cost per TEU
moved) than vessels tied to the artificial restrictions of Panama. However, being expensive
(40,000 US Dollars/day) they will be even more selective in the load centre ports that they
serve. It is reasonable to assume that such ships will call at Pusan and serve TREDA ports
with feeders from there. If the Trans Siberian Railway becomes a major factor in Asia/Europe
trades, these ships might call at Vostochny. Being wider, they may not require much greater
depths. However, they will require POST PANAMAX cranes that can reach out by at least two

more container widths (4.8 m). These cranes will require more than usual strength at and
under the face of a containership berth.
While POST PANAMAX ships are not likely to call at TREDA ports before the year 2000, it is
possible that PANAMAX ships will call at Rajin and Vostochny offering direct trans-Pacific
connections. It follows that construction of new berths should include facilities for these large
vessels.
Maritime Trade After Year 2000
Predicting the nature of the containership system in year 2020 is neither easy or necessary.
We say this because short and medium term port infrastructure needs are reasonably obvious,
and port construction is likely to be in stages.
Containerships are not likely to grow much beyond 8,000 TEUs because such large vessels
would consume too much time in unproductive port work. There may be a new generation of
port cranes that straddle ships, that is they are supported both by the berth and some structure
on piles outside the ship.
Japanese yards are experimenting with radical feeder ship designs. These are generally
trimarans or catamarans that travel at thirty knots or better. Such vessels are already common
in short sea passenger trades. If they can carry containers, the nature of the feeder systems
could be fundamentally different. Some speculate that present hub load centre ports would
grow at the expense of neighbouring feeder ports. These new designs could influence the
balance between sea and air movements.
Recent Pertinent Developments
In April 1994, Sea-Land, an international transport conglomerate, announced that they will
invest in new container port facilities in Vostochny, and new better management
arrangements. Sea-Land already operates 3,400 of their own container rail cars on the Trans
Siberian Railway (TSR) and advised TSR management on operation of dedicated express
block trains.
Japan has recently approved 40 million US Dollars in credits to Kazakhstan for improvements
in the rail link between the Yellow Sea, Beijing through Urumqi, and in the west, Pakistan,
India, Iran and Turkey. This, the TSR, and sea routes are all rivals to the TREDA ports.
Interim Short Term Steps

In the absence of public container ports, ro-ro operations are a useful short term device. These
are already common in many smaller East Sea (Sea of Japan) ports linking shippers in Japan,
DPRK, ROK and China. While most studies question the feasibility of a deep sea port
development at the mouth of the Tumen River, the same might not be true for a shallow draft
ro-ro facility. Vessels drawing as little as 3.7 m can and do navigate across the East Sea (Sea
of Japan), this could provide limited competition to the deep sea terminals at Rajin and
Zarubino. Improvement of highway quality and load bearing capacity is a critical factor for the
success of this transportation mode.

Air freight often can be justified as a short term mode for textiles, fresh and frozen foods and
manufactured goods. Movements could begin immediately at Yanji where truck and rail
connections are operable. In Eastern Europe, emergency air freight movements have enjoyed
use of low cost Russian aircraft rendered surplus by reduced defence activities. These
generally call for inland container depots (ICDs), some with customs clearance staffing. Such
ICDs tend to have low costs and to be privately financed.

There are now many small coastal ship services in the TREDA area, most of these employing
small ro-ro type vessels. The study team travelled on one of these. In the short term absence
of road improvements, this type of cargo transport could be expanded. This has been
experienced in other developing areas.

Logistic/Distribution Management

The Railroad (Northeastern Asia Railway and Port Group Company Ltd.), UNIDO and the
consultants have all agreed that there must be staff with traffic management skills in the
Railroad and at other transport services. While not immediately available, these skills can be
taught over a period of two to three years by outside experts. Location of ICDs and container
stuffing terminals are set with the inherent advantages of truck, rail and water modes in mind.

Packing and packaging are cost and service elements. Modern (especially Japanese) plant
location decisions are made with transport/logistic considerations in mind. Documentation,
insurance and private carriage (owned trucks, etc.) are all subject to logistic analysis.

Non TREDA Transport Options (Cargo Flow)

While precise economic or cargo flow forecasts are virtually impossible, it will eventually be important to know what types and volumes of cargoes will move through TREDA ports.

Present estimates appear to justify short term use of existing Zarubino and Rajin berths plus the immediate construction in each port of two PANAMAX container berths. Further additions will normally be preceded by more accurate demand forecasts.

Studies to date have made no mention of the options available to exporters and importers in Northern DPRK, Primorsky Krai, Heilungkiang, and Jilin. Already funded or planned improvements to the Russian wide gauge and Chinese standard gauge rail systems will attract cargoes for Western Asia and Eastern Europe. Water carriers serving Yellow Sea ports will always be a factor. It may develop that most exports and imports through TREDA ports will be for Pacific Basin trades, primarily with North and South America, Japan, ROK, Taiwan, Australia, New Zealand, Bay of Bengal and ASEAN countries.

Inland Container Depots (ICDs)

Having no deep water port on the East Sea (Sea of Japan), the TREDA area of China has a special need for inland container ports or ICD's. These are for general cargoes, mainly for container stuffing and unstuffing. It is assumed that loaded and sealed containers will move in bond and untouched through DPRK and Russia to and from TREDA ports. Inland ports or ICDs are common parts of intermodal/logistic systems worldwide, and COSCO already operates over a hundred of these, one in Harbin and one soon in Changchun.

ICDs Described

In seaports land, labour, and support services are expensive. The ideal port, Rotterdam or Singapore for example, is devoted almost entirely to the highly mechanized movement of containers to and from vessels. If break bulk cargoes are handled, they are from the immediate port hinterland (say twenty miles away) and are stuffed/unstuffed in what is called a CFS (container freight station) in or near the major port. The logistic object is always to create a unit (loaded container) as far back in the system as is possible.

Most large ICDs are at rail terminals and are devoted to consolidating cargoes delivered by trucks. Thus the inherent advantages of the two modes are best employed. These tend to have customs officials present so that boxes can be sealed and cleared to

destination without
being opened. Some ICDs are at airports, generally also to receive from or deliver to trucks.
Many large trucking companies operate their own ICDs, usually without customs facilities.
These enable them to receive small shipments for consolidation into containers. Large
industries, auto makers for example, operate their own ICDs or consolidation centres.
While Non Vehicle Owning Common Carriers (NVOCC) do not usually own transport equipment, many do operate (lease, own, or contract) inland terminals. So also do some ship
lines and shipping consortia.
State of the Art in TREDA
ICDs and multimodal transport are not new in China or Russia. Of necessity they are at rail
gauge transfer points such as those in the TSR system at Brest (Polish border), Chop
(Czechoslovakia and Hungarian borders), Ungeny (Romanian border) Dzhufla and Astra (Iran)
and Termez and Kusshka (Afghanistan). COSCO seeks to load containers as far back in their
system as possible, having over a hundred depots including one at Harbin.
The backbone of the container system in China is the overloaded rail system. Dedicated block
container trains already run on several routes. Outside companies are beginning to gain
permission to install their own ICDs. For example, Kuhne and Nagel own one in Dalian and six
other locations, and have offices in Changchun and elsewhere in China. Others will follow, but
progress will take time.
RECOMMENDATIONS
On the assumption that road and rail connections to Zarubino and Rajin are proceeding, the
following steps are recommended and are listed in order of timing priority.
Formalize Customs Procedures
Initially, this should include creation of an ICD at Hunchun with whatever DPRK and Russian
Customs staff are needed to clear and seal containers for transit to and through the ports of
Zarubino and Rajin. Note that these containers are never to be opened or manipulated in
Russia or DPRK. The same arrangements should be attempted for loaded and sealed trucks
that may move on ro-ro vessels. Eventually, this procedure will be duplicated at other load
centre points in all three nations, Yanji and Changchun, for example.
Establish Containerport Expert Management
The business of operating a container berth is highly specialized. Generally experienced

outside contractors such as P. and O. are retained to manage initially, and eventually withdraw in favour of trained local personnel. Often, the external managers finance cranes and support equipment under a variety of established contract forms. At the beginning, the contractor must have absolute control including deciding about the use of ship's gear.

Plan ICD Expansion and Organizations

Recognizing the problems in the TREDA port system, it is in the interest of the Tumen Programme to promote ICDs in every way possible. These generally do not involve major capital investments. Furthermore they support the general objectives of the programme in that they transfer labour intensive activities inland to existing population centres.

Authorities at Hunchun have already begun to establish ICD facilities. Outside NVOCCs ship lines and forwarders from Europe and Asia are also planning or operating their own ICDs.

Need for government finance may be limited. However, these impose responsibilities on governments for road and utility connections and operating permits, to mention a few issues. It follows that the TREDA management must appraise the situation and have some role in planning ICD expansions.

Two PANAMAX Container Berths Each in Zarubino and Rajin

While cargo flow and related economic studies are preliminary, it is clear that there will need to be at least two modern berths in each of the two key ports, and that this need will arise before year 2000. Design and planning should, in both cases, consider expansion possibilities as indicated in earlier studies. Creation of facilities for obvious needs should not await approval of more ambitious plans based on uncertain forecasts. Each of these initial berths should have two Paceco type container cranes.

Begin Logistic/Distribution Training Program

While ship lines (COSCO/FESCO/Sea-Land, etc.) have sophisticated understanding of traffic management matters, this must be developed in the Railroad and possibly in several other government or TREDA agencies. Accepting guidance from forwarders, non vehicle owning common carriers (NVOCCs), and carriers may be a short term necessity, but these may not have TREDA interests in mind. As an initial minimum, a professional staff must be trained and established in the Railroad organization.

Upgrade Economic Analysis of Cargo Flow

The foregoing recommendations carry modest costs and appear to be fully justified by studies already completed. Ambitious road, rail, port and terminal plans have been mentioned but not yet justified by any reliable economic data. It follows that there must be more detailed economic studies, and that these should be delayed long enough to gain by initial experience with the steps proposed above.

IMPLEMENTATION PLAN

Workshop meetings and studies, especially those in 1994, have established that needed actions which are relatively low cost should be taken now, and that the TREDA project not be stalled while uncertain, high cost, long range matters are debated. None of the six recommendations of this chapter call for immediate capital funding. Several, if pursued, will provide data and evidence on the feasibility of further action, investments and studies.

In theory, Port Authorities provide infrastructure, namely ship berths, container cranes, transit sheds, and some handling equipment, then try to recover their investments through various rental and contract payments, also from dockage and wharfage charges. In fact, most ports fail to recover their investments, but justify this by impact studies. These allege (sometimes correctly) that port investments create jobs and wealth in the port city, region or nation.

The TREDA project envisions a multi-national approach which may place individual port authorities in less than full control. If a multi-national body provides finance, it will also require a considerable degree of security and operating command. A first step will be in identifying the beneficiaries in the initial two berths in Zarubino and Rajin. While exact costs must be subject to precise on-site studies, a standard container berth could cost between twenty and fifty million US dollars, depending on sub-soil and other conditions. The cost for a crane and supporting handling equipment should add about twenty million US dollars to this.

RAILWAY TRANSPORT NETWORK

OBJECTIVES

The infrastructure team's mission entailed:

- a review of the current rail network within TREDA;
- an assessment of its potential;

a review of the system connections;
the overall strategy to link with the existing National Railways; and
making specific observations and recommendations.

EXISTING SITUATION

Railways Within TREDA

The railway network within TREDA can be considered as the most efficient and furthest developed transportation mode for supporting the economic development of the area. This can be said since the railway network, although not yet completed, is much further advanced than the highway network in this area. As well, there seems to be a shortage of highway vehicles in TREDA. The railway network, once completed, will be easier to maintain than the highway network and many of the commodities to be moved within TREDA are containerized or in bulk, and lend themselves to rail transportation since transport costs are generally lower.

Within TREDA, railways use two different track gauges. The Russian gauge (sometimes referred to as "broad gauge") is 1520 mm between rails while the Chinese and DPRK use the "standard gauge" of 1435 mm. Where the two gauges are constructed within one another on the same track bed, the term "composite gauge" is used (Picture 3.1). Should the system be constructed adjacent to one another on the same track bed the term "dual track" is used. A composite gauge network exists in the DPRK between Tumengang and Rajin and from Rajin to Chongjin.

PICTURE 3.1

Currently a phased approach to railway network improvements has been planned by the major developer in the area, the Northeastern Asia Railway and Port Group Cp. Limited based in Jilin, China. Phase I encompasses the necessary construction of the missing links and rehabilitation of the various rail lines within TREDA. Phase II includes various expansion scenarios including ports, marshalling and gauge change facilities, additional dual gauge or composite track rail lines and international passenger terminals.

The Russia (Zarubino) - China (Tumen) Link

At present, the line connecting the Port of Zarubino with Hunchun and on to Tumen is not yet complete. Russian gauge exists from the port to Kraskino but a shortage of funds has resulted in a gap of 12 km from Kraskino to the China - Russia border which remains

unfinished. This
section does not require any major structures and only 5 small bridges, which will be simply
supported concrete structures.
The Gold Ring Stock Company of the Russian Far-East Railway Bureau will provide an
estimated 12 million US dollars to finish the work which includes a fibre optic cable for signals
and telecommunications. China has agreed to provide the necessary labour so that the link
can be completed by the scheduled date of June, 1994.
From the Russia - China border all of the subgrade and embankment work is finished and the
piers for the major Hunchun River crossing are in place. Precast beams have been
manufactured and are awaiting erection this spring to complete the bridge crossing. Track
laying and ballasting from Tumen to Hunchun is virtually complete but there has been no
signal installation to date.
The DPRK (Rajin) - China (Hunchun) Link
In Phase 1, a standard gauge link between Hunchun and Saebyol in DPRK is required, and an
agreement for construction has already been signed between the parties. The cost of the
connection which is 5 km in length and must cross the Tumen River is estimated to be about 5
million US dollars.
The Russia (Zarubino) - DPRK (Rajin) Link
Currently Russian gauge track exists between Zarubino, Rajin and Chongjin. Standard gauge
track also exists on this same line from Tumengang to Chongjin. This composite gauge section
allows cargo from Chongjin or Rajin destined for points in Russia to pass directly, without the
need for transshipping or a wheel change, thus avoiding the inherent delays and excess
handling incurred in these facilities. For certain time sensitive cargo, this provides a
competitive advantage favouring these ports.
China - Russia Cross Border Traffic
There are four border crossing points that connect to the Russian Federation from China, two
of these directly and two via other countries. The far western route through the Chinese city of
Urumqi and then through Kazakhstan does not directly relate to the TREDA project although it
is significant because it is a shorter route to Moscow and Europe from China than any of the
other three railway gateways. The second of these gateways crosses between China and

Mongolia at Erenhot, Nei Mongol (Inner Mongolia), China to Zamin Ude in Mongolia. After traversing Mongolia through Ulaan Baatar, the route enters the Russian Federation at Naushk, south of Lake Baikal. The estimated volume of through traffic between China and the Russian Federation is 0.37 million tonnes, both directions combined. The third border crossing point is between Manzhouli, Nei Mongol and Zabaykalsh, Chitinskaya Oblast, Russian Federation.

Import and export traffic from the Chinese side is 1.75 and 0.81 million tonnes. The fourth border crossing by rail is at the gateway Suifenhe, Heilongjiang, China to Pogranichniy, Primorsky Krai, Russian Federation. The import and export traffic from the Chinese side at this gateway is 0.76 and 0.21 million tonnes.

Details by commodities are shown in Appendix D.

National Railways Beyond TREDA

It is generally accepted that many parts of the National Railway Systems of Russia, China, Mongolia and the DPRK are in need of upgrading, modernization and rehabilitation. These projects are underway with financial support from various International Funding Agencies. This report provides only an overview of these systems and the efforts being made to remedy certain problems within these systems. It must be understood that the success of TREDA depends on sound, reliable, competitive and economical transportation, particularly that handled on the rail networks beyond TREDA.

The process of reducing paperwork and simplifying customs procedures so as to provide a convenient and more efficient transportation network between the countries, does not seem as far advanced as are the plans for development and construction of the various physical facilities necessary to provide an integrated network.

The Network in Russia

The Trans Siberian Railway would be the key linkage in delivering major cargoes from TREDA Ports within Russia (Vostochny, Nakhodka and Vladivostok) to Europe and to the Russian domestic and other markets. While the network suffers from seasonal operating difficulties caused by harsh climate all indicators point to surplus capacity in the system. For traffic originating from or destined to TREDA ports, in the Ussurysk area the line is reported to be nearing its capacity of 6 million tonnes. This capacity can be increased to

about 8 million
tonnes annually with signal upgrading, selective siding extensions and increased ordinary
maintenance activities. Further north, a major capacity restriction reportedly is a single track
bridge over the Amur River. Rehabilitation and a study to determine the feasibility of double
tracking over this bridge are underway.

A list of railway projects in the planning or pre-planning stages is included in Appendix C.

The Network in China

Major overhauls of the entire rail system throughout China are currently underway. Near
TREDA, the line connecting Jilin and Changchun is currently at capacity and is handling only
30 % of the required demand for transportation. Double tracking of this portion of the rail
network has been recommended. A complete rehabilitation of this line is required including:

- replacing the existing 43 kg/m rail;
- cross tie (sleeper) replacement program;
- bridge upgrading program;
- signal systems replacement and communications upgrading;
- replacement of steam locomotives with diesels.

The Network in the DPRK

Most of the existing network in the DPRK was constructed in the 1930's. Rail is light (38 kg/m)
and much of the line is in need of upgrading and rehabilitation. The line that runs from
Changjin to Hoeryong and Haksong is undergoing a process of both modernization and
electrification. When this process is completed in 1995, coupled with an upgrading of the
signal system, a new traffic control system and the replacement of steam traction, the capacity
of the line will have tripled.

Proposed Development

Inland Terminal and Gauge Change Facility

The existence of two gauges from Zarubino to Hunchun would dictate that a gauge change
marshalling facility and transhipment centre be built. A plan to build the facility at Hunchun
exists. The facility is in the design stage and plans to complete this facility are included in
Phase II at a projected cost of 25 million US dollars. This does not include the cost of the
operating system and terminal management software.

The area surrounding the proposed rail yard has been reserved for industrial development.

Hunchun International Passenger Terminal and Hotel

This 21 story, 62,000 square meter facility is planned in Phase II and the

proposed cost
including a coal fired central heating system is estimated at 23 million US dollars. It is to be
located close to the train station and will include an international bus terminal, customs
clearance, visa acquisition centre, international shipping offices and a hotel. These facilities
would cater to the greatly increased business and tourist trade that the area is anticipating will
develop.

COMMENTS AND OBSERVATIONS

Much of the cargo to be handled within TREDA will be best moved by railway. This includes
bulk commodities such as steel, grain, corn, cereals, timber, ore, fertilizers and minerals.

Currently, due to lack of storage facilities at origin and destination, cereals, wheat and
fertilizers are shipped in bags or sacks. Construction and development of storage and loading
and unloading facilities would permit this type of cargo to be handled as bulk commodities.

Alternatively, if the trend continues towards the use of good quality, large capacity bags at
source, containers could be used. Both of these shipping modes would be of particular benefit
for development or expansion of export markets.

It appears to us that the work certainly must continue to link the network within TREDA. Once
the network is complete and the split between the different gauges is rationalized, this network
will have the capacity to handle at least 8 million tonnes annually. This figure can probably be
increased dramatically by implementing some alternative operating strategies which can be
implemented in phases without the need for major capital expenditures.

Railway Track Gauges

It has been pointed out previously that two different gauges are used on the railways in this
area. Russian gauge is 1520 mm while China and DPRK use standard gauge at 1435 mm.

This inconsistency complicates the objective of providing efficient transportation services since
the resulting transfer of freight cargo from one rail car to another of the required gauge or the
changing of railcar bogies is inefficient and costly.

There are advantages to building composite gauge rather than two tracks in that construction
costs are lower, requiring only one-half as many sleepers (ties) and a right-of way about one-
half the width. The savings in sub-grade, ballast and sleepers is significant. On the other hand,

capacity is reduced by a factor of between 0% and 50% depending on the distribution of traffic
between the two gauge types - the greatest reduction occurring when the traffic volumes are
equal.
The disadvantages of a network that must cater to two gauges are obvious. Wagons and
locomotive power cannot freely move from one gauge to the other without a bogie (wheel)
change. If a bogie change is not made then cargo must be transshipped to wagons of the
other gauge or to a second mode (truck). This causes enormous expense in construction of
gauge change or warehousing facilities, congestion, inefficient usage of investment and
damage to cargo due to additional handling.
The Hunchun to Kraskino Gauge Question
Currently the rail line between Tumen and Hunchun is built as standard gauge while the rail
line between Hunchun and Kraskino is to be constructed initially as Russian gauge, with a
gauge change or transhipment facility at Hunchun. This decision was agreed to between the
Northeastern Asia Railway and Port Group Company Ltd., and the Gold Ring Stock Company
of the Russian Far-East Railway Bureau, and was based on the need to handle commodity
exchanges between the Russian Far East and the Chinese Provinces of Jilin and Liaoning as
well as the central and southern provinces. Market studies to support this need have not been
located, but experience elsewhere (see the section "China-Russia Cross Border Traffic") does
not indicate that high volumes can be expected.
These two parties have apparently agreed to upgrade the Hunchun to Zarubino track to
composite in Phase II by adding the standard gauge tracks to the existing road bed.
The Russian National Delegation has further indicated that a gauge change or transhipment
facility will then be put in place at Kraskino as well to handle traffic received from China.
The consultants believe that Hunchun-Zarubino traffic will rapidly become dominant on the
Hunchun-Kraskino section and that the installation of standard gauge track from Hunchun to
Zarubino will become urgent at a very early date.
Considering this, the consultants' recommendation is that the initial construction of the line
between Hunchun and Kraskino be standard gauge, that the section from Kraskino to Zarubino

be made composite and that a small gauge change transhipment station be built at Kraskino to handle China-Russia trade.

The Consultants find that the concept where the receiving country must carry out the gauge transfer, thereby requiring two gauge transfer facilities with attendant increased delay, unreliability, problems of wagon shortage, etc. are inappropriate to transport system design for a market economy. When transfer of loads due to differing gauges of connecting railways is essential, a much more efficient operation could be conceived where a joint venture company does the transfer to and from both gauges, thereby loading wagons as they are released from loads moving in the opposite direction and achieving faster and more efficient operation.

Naturally new agreements to cover this more modern freight handling approach will be necessary, but we expect that these arrangements need not be very complex.

As China-Russia trade develops, the economic growth in the region, because of the short distances involved between TREDA and the other cities of Primorsky Krai, freight traffic will likely be most efficiently, economically and rapidly handled by truck on the improved roads planned in the area and not by rail. To expect such traffic to travel only by rail would be a disincentive to industrial growth. Indeed, roll-on/roll-off transportation on coastal ships as well as local container delivery up and down the coast from the major Port of Nakhodka should be encouraged where it might be the most suitable mode of transport.

The Hunchun Yard

This facility would appear to be overdesigned. Marshalling yards are a disappearing facility on most modern railway systems. If possible, cargoes should be moved from origin to destination directly, bypassing such facilities. This strategy provides for fewer delays to customers' cargoes, lower handling costs and more efficient usage of freight wagons.

Port Facilities

Expansion of the various port facilities will require building additional rail sidings and commodity storage facilities. These plans seem well integrated at Rajin, Zarubino and Vostochny.

Modal Share

When assessing which transportation mode should be considered at various locations within TREDA, the following guidelines should be considered:

Rail is an ideal mode for the transportation of bulk commodities such as steel, grain, corn, cereals, timber, fertilizer, ore and other minerals.

Highways, on the other hand, are ideal for shorter distances,and perishable and high value goods, which require the flexibility and efficiency offered by this mode.

Passenger service, where trips are short, are also best provided by highways. The development of a rail passenger network within the short distances involved in TREDA should not have a priority unless it is to become an integral part of a much larger passenger system.

Railway Standards

Visual observation of the railway facilities indicate that railway design and construction standards within Russia and China are high. This report is not able to comment on the DPRK situation due to the lack of first hand knowledge and information.

Mongolia Railways

Land-locked Mongolia has much interest in the possibilities of using the TREDA ports for international trade. A discussion of the existing rail situation and potential expansion plans follows.

The Idea of a Landbridge

This would serve the purpose of shortening rail transport from TREDA to Western Europe.

It has been suggested that upon completion of the links within TREDA that a connection could be made to the Trans Siberian Railway (TSR) through northeastern Mongolia. This link would pass through Changchun to Arxan on the Mongolian border and through Choybalsan to connect with the TSR at Borzya. It would create a route about 1700 km shorter than the existing all Russia overland route from Vostochny, Nakhodka and Vladivostok through Ussurysk. This new route would also provide Mongolia with a shorter and more direct route to the East Sea (Sea of Japan) than the current access through Russian ports, but not necessarily shorter than the existing railway line from Ulaanbatar to Tianjin. The tracks would be standard gauge through China and to a gauge change facility in Mongolia for connection to the TSR.

This landbridge would require extensive rebuilding and modernization. In China the portion between Ulanhot and Arxan contains severe grades of 2.15% and excessive

curvature. A
complete modernization, realignment and grade reduction strategy must be considered. In
addition the portion between Jilin and Changchun is already at capacity and a double tracking
program is being considered. In Mongolia the portion from Arxan to Choybalsan of about 195
km requires complete rebuilding as only roadbed and track structures remain. Total cost of this
project, including the rehabilitation of the Chinese network and the rebuilding and
modernization required, is approximately 1 billion US dollars.
It is our understanding that this extension of the railway through Mongolia is currently being
reviewed. The results of this study must be closely considered before any conclusion is drawn.
There is an existing railway link to the Transiberian Railway from China through Manzhouli on
the China-Russia border and a new link through Arxan and Choybalsan would directly parallel
that existing link. For these reasons and, based on the information and market data available,
it would be inappropriate to recommend this option at this time.
Choybalsan to the Chinese Border
This would shorten the route from Choybalsan to Ulanhot.
There is an existing branch-line of Chinese Railways close to the Mongolian border at Yirshi
near Arxan, about 240 km northwest of Ulanhot, Nei Mongol. This branch line joins the other
lines of Chinese Railways at Baicheng, which is a branch-line hub station with connections to
Harbin, Changchun, Tongliao and Manzhouli (on the Russian border). In examining these rail
connections, it will be necessary to consider whether the branch lines on the Chinese side are
capable of additional traffic or whether upgrading would be necessary. The existing
connection to China from Choybalsan is over the existing track to the Russian border then
through Borzya which is on the branch line to Manzhouli, about 110 km southeast of Borzya, or
a total distance over existing track (Russian 1520 mm gauge) of 420 km, from Choybalsan to
the Chinese Railway.
Choybalsan to Öndörhaan and Ulaanbaatar
This would provide railway transportation to the interior of Eastern Mongolia. It would be an
east to west line extending the existing railway that runs from the Russian border to
Choybalsan westward to Ondorhaan, about halfway to Ulaanbaatar, and then on to

Ulaanbaatar, a distance of 650 km. The technical and economic feasibility of these extensions
which would further open up Eastern Mongolia to the Russian Railway network should be
examined, recorded and published as input for future transport planning.
Move Gauge Change Facility to Ulaanbaatar
This would shorten import and export shipping time to and from Ulaanbaatar.
A most important Railway link from Mongolia to foreign trading ports is the existing north-south
line from the Russian border through Ulaanbaatar to the Chinese border. Because this line is
Russian gauge, all import and export traffic from/to China is delayed at the border while freight
is unloaded, stored and then reloaded when wagons are available for the other country's
national network. The World Bank reports that the average delay to freight is 17 days with
some freight waiting much longer.
A new gauge transfer station has been constructed on the Mongolian side at Zamyn Uud and
while this will improve the technical efficiency of transfer of freight inbound to Mongolia, it won't
do enough to improve the overall flow of import and export traffic to/from the port of Tianjin and
other accessible Chinese ports.
A long-term solution to improve the flow of traffic will be to change the track gauge from
Russian (1520 mm) to standard (1435 mm) on the line south of Ulaanbaatar to the Chinese
border while relocating the new transfer station from the desert border crossing point of Zamyn
Uud to the city of Ulaanbaatar. In this manner, none of Mongolia's import-export traffic will be
subjected to gauge change delays - traffic destined for Russia from Ulaanbaatar will move
over Russian gauge track and traffic destined for China will move over Chinese (standard)
gauge track, both without undue delay at the borders.
The Chinese Ministry of Railways would be willing to discuss an interchange agreement
whereby Chinese trains would be allowed to proceed right to Ulaanbaatar. Transit traffic
between China and Russia would then pass through the new gauge transfer point at
Ulaanbaatar which would replace existing gauge transfer stations at Erenhot, China and
Zamyn Uud, Mongolia.
RECOMMENDATIONS
Gauge Between Zarubino and Hunchun
The addition of standard gauge between Zarubino and Hunchun should be given high priority

so that the need to use the Hunchun gauge change or transhipment facility can be eliminated
and through train traffic can be accommodated.
This action will significantly reduce shipping delays to the customer and make the use of the
Zarubino port more attractive.

Construct Missing Links

Phase I construction includes the link from Zarubino to Hunchun and Rajin to Hunchun. The
completion of these two links will allow the market place to determine which of these ports they
will use. Map 3.1 shows the railway network which will be available for the market place to
choose from.

MAP 3.1

Hunchun Marshalling Yard and Transhipment Facility

Due to today's tendency to run more through trains from origin to destination, the necessity for
a classification yard of the magnitude proposed should be analyzed. It is quite possible that the
size could be reduced.

It should be noted that there has been no provision in the cost estimates for the systems
required to manage these classification facilities. These include automatic classification, weigh
in motion and automatic car retarding, and are extremely costly.

Financial Feasibility Studies

We understand that the Northeastern Asia Railway and Port Group Company Ltd. is unable to
finance the construction of the marshalling and gauge change facility and the international
passenger terminal.

Financial feasibility studies must be prepared in the format recognized and accepted by
international banking agencies like the World Bank and the Asian Development Bank, in order
that such financing agencies may be approached for the necessary funding of these two
facilities.

Market Demand Studies

One of the great difficulties experienced during this review was the apparent lack of realistic
rail oriented market demand studies. It will be necessary to undertake these studies in
conjunction with the information supplied in the UNDP sponsored Regional Development
Strategy to be published in late 1994. The recommendations of the market demand studies will
give a forecast of the traffic and its make-up, which the railways in the three countries should

consider when examining the need to expand existing facilities.

Management Information Systems

There is no apparent interface between the information systems of the national railways and the railway/ports operations within TREDA. This must be reviewed in detail to streamline the flow of paper within the area. This is especially required for customs inspections which will have to be streamlined to allow for the through movement of bonded freight cars to inland terminals. This will require the creation of an electronic information interchange system.

A tracking system that interfaces with the systems in place with the three national rail networks will also be required.

Rail System Expansion

Capital intensive expansion projects are a traditional way to create capacity on a railway. They are not necessarily the best or most efficient way. It is imperative then that careful examination of all alternatives be undertaken rather than simply embarking on capital intensive expansion plans. For example, double tracking is a simple but very expensive solution for increasing line capacity, and before it is done the following should be addressed:

Review all operational choices, including alternate traffic control methods, line upgrading, longer trains, computer assisted dispatch, upgrading of signalling, selective siding extensions and double tracking through selected track sections;

Review options that would increase axle loadings to 25 tonnes as planned throughout China;

Eliminate steam traction where possible. The success of railways depends generally on how much cargo each train can haul. With the very steep grades and the dominance of heavy haul bulk cargoes, diesel traction is more effective than steam.

Passenger Rail Strategy

Passenger trains and freight trains do not have the same operating characteristics and therefore careful consideration must be given before passenger trains are introduced onto a freight railway. Examine passenger rail service in the context of a national passenger rail strategy and not just a TREDA strategy. Passenger movements over short distances may best be handled by highway motor coaches with their inherent flexibility, until volumes reach the high levels of "commuter" density.

Explore commuter rail as a long term option within TREDA.

Roadrailer
During the meetings with various parties much was said about the need to deliver fresh food, produce and fish to marketplaces especially in ROK and Japan. These markets demand overnight service for the commodities involved. This would seem the ideal market over short distances that are suitable to Roadrailer application. Roadrailers are vehicles that can travel on both highways and railways as they have an interchangeable wheel system. The Roadrailer vehicle can also be mounted on either a standard gauge or Russian gauge railway bogie. They essentially can be rolled on and off the railroad or highway to provide door to door transit for these very time sensitive commodities.

IMPLEMENTATION PLAN

For the ports at Zarubino and Rajin to support economic development in TREDA, the following specific actions must take place for the rail network to provide efficient transportation:

- Prepare market demand studies;
- Complete the link between Zarubino and Hunchun. This is an integral part of the rail system;
- Accelerate the addition of standard gauge track between Zarubino and Hunchun;
- Re-consider plans for the Hunchun Marshalling Yard;
- Complete the link between Hunchun and DPRK at Saebyol;
- Acquire an electronic tracking system for use within TREDA. The system must be expandable and should ultimately be integrated or interfaced with the different National systems;
- Rationalize, upgrade and rehabilitate the rail network within TREDA, building composite gauge track only where there is no other choice.

HIGHWAY TRANSPORT NETWORK

OBJECTIVES

This report will evaluate the existing highway network and establish the initial basic network which will link all the major highway transportation origins and destinations within the region. Once in place the network will then be expandable, in an incremental way, to meet the demands for increased levels of service as development and industrialization occur.

EXISTING SITUATION

The Infrastructure Team was able to personally view and drive on some of the key inter-city

links in the TREDA. Those that were not looked at in this manner will be reported on the bases
of available information from other sources.

Current Physical Condition

The existing highways throughout TREDA are generally in poor condition, not suitable for
passenger cars, highway buses or truck transportation in an economically developing region
that needs the benefits derived from a fast convenient and accessible highway network. There
are a few exceptions to this general statement on condition and these have been noted.

While it is necessary to look at the highways as a total network serving TREDA without
national boundaries, however to put it all in perspective, it is best to report individual roads on
a national basis.

Russia - Primorsky Krai (Map 4.1)

Section R1 - Vladivostok to Artem (Vladivostok Airport) [50 km] is mainly a 2 lane urban road
in generally poor condition. The portion within Vladivostok is a 4 lane urban facility with a
boulevard median in some locations and in others streetcar tracks are within the roadway.

MAP 4.1

Section R2 - Artem to Nakhodka [95 km] is a 2 lane rural section highway, with some local 4
lane urban sections through small communities. Overall the highway is in poor condition
making it very hard on all types of vehicles to withstand the physical abuse they are subjected
to if any reasonable speed is attempted. Horizontal and vertical alignment are extreme in some
locations particularly in the hilly area towards Nakhodka. Road construction is underway in
some areas to alleviate the severe horizontal and vertical conditions and this work is to be
completed in 1994.

Section R3 - Nakhodka to Vostochny [15 km] is a relatively new 2 lane highway in reasonable
condition. The urban section within Nakhodka is in good condition and is of 4 lane capacity.

Section R4 - Artem to Slavyanka [170 km] is reported to be a 2 lane road in very poor
condition and with a very low level of traffic.

Section R5 - Vladivostok to Slavyanka [70 km water crossing] is served year round by an
automobile and light truck ferry boat. The crossing time is about 2.25 to 2.5 hours. The ferry
requires vehicles to turn around on board or to either back on or back off.

Line-up storage
capacity at Vladivostok is very limited.
Section R6 - Slavyanka to Kraskino [55 km] is a 2 lane rural road in very poor condition.
Section R7 - From Zarubino Port to the intersection with Section R6 [10 km] is a 2 lane rural
gravel road with reasonable horizontal and vertical alignment. This road is grade-separated
from the railroad where they cross. Within the urban section of Zarubino the turning conditions
are restrictive. An asphalt pavement plant has been set up near Zarubino and this road should
be paved in 1994.
Section R8 - Kraskino to the Chinese-Russian border [30 km] is a 2 lane rural road in very
poor condition. Portions of the road are under reconstruction and the work should be finished
in 1994.
Section R9 - Kraskino to the DPRK-Russian border [50 km] is reported to be a 2 lane rural
road in very poor condition. There is no road bridge crossing the Tumen River and the road is
thus discontinued.
A list of projects in the planning or pre-planning stage is included in Appendix C.
China - Jilin Province (Map 4.2)
Section C1 - Chinese-Russian border to Hunchun [15 km] is a newly constructed 2 lane
concrete paved road in excellent condition.
MAP 4.2

Section C2 - Chinese-DPRK border to Hunchun [15 km] is a 2 lane rural road in poor condition
with a narrow road section. A 2 lane long bridge connects with the DPRK across the Tumen
River.
Section C3 - Hunchun to Tumen [60 km] is a 2 lane asphalt paved rural road opened in 1989
and in reasonably good condition. The shoulders are narrow and soft.
There are some long and fairly steep grades in sections with speed restricting horizontal
curves. Narrow shoulders make it difficult for vehicles to pull off the travelled portion of the
road when it is necessary to stop. This causes vehicles to park partially on the road, restricting
the following traffic and creating a potentially dangerous situation.
Section C4 - Tumen to Yanji [50 km] is a 2 lane asphalt paved rural road reported to be in
reasonably good condition.
Section C5 - Yanji to Longjing [12 km] is a 2 lane asphalt paved road in very poor condition.

This road is reported to have a poor subgrade structure which results in very high maintenance requirements each year. The shoulders are narrow and quite soft with some extensive sections of severe curves. A feasibility study has been completed and consideration is to be given to a 4 lane highway with tolls.

Section C6 - Longjing to Ssanho [40 km] is a 2 lane road in extremely poor condition and not negotiable by long heavy trucks at certain times of the year. There are sections of long grades and very restrictive horizontal and vertical alignments. Reconstruction of the road is in evidence and this work should be completed in 1994 or 1995. A 2 lane bridge crosses the Tumen River near Ssanho.

Overall, within Jilin province, there are 28,373.2 km of highways. They include:

National highways: 2,879.4 km (under the jurisdiction of the Ministry of Communications (MOC), but being taken care of by the Province for the MOC);

Provincial highways: 2,757.7 km (connecting with the major national highways, under the jurisdiction of the Province);

County level roads: 6,597.2 km (under the jurisdiction of the prefecture governments);

Inter-village roads: 14,175.4 km (under the jurisdiction of counties); and

Special highways: 1,963.5 km.

The six national highways are:

Tumen to Ulanhot - 930 km;

Jian to Xilinhot - 400 km;

Shenyang to Mingshui - 283 km;

Beijing to Harbin - 300 km within Jilin Province;

Heihe to Dalian - 400 km within Jilin Province;

Hegang to Dalian - 579 km within Jilin Province.

The national highways connect with 12 provincial roads, and inter-county and inter-village roads. All the 934 towns in the province are linked by highways. However, there are still 1,391 villages in the total of 10,151 villages not connected by highways.

DPRK - North Hamgyong Province (Map 4.2)

Due to the lack of visas to enter the DPRK, it was not possible for the team to personally examine the condition of the highway network in this country. The following information has been taken from the report produced by the Committee for the Promotion of External Economic Cooperation of the DPRK. There is no information available to indicate when any of the construction contemplated will be completed.

Section K1 - Chongjin to Rajin [90 km] is a 2 lane partially paved rural road. Due to the hilly topography the road alignment is poor and the road should be reconstructed.
Section K2 - Rajin to Saebyol [120 km] is a 2 lane partially paved rural road. It also has poor grades and alignments due to the hilly nature of the country.
Section K3 - Saebyol to Namyang [35 km] is a 2 lane gravel rural road in poor condition.
Section K4 - Chongjin to Hoeryong [85 km] is a 2 lane partially paved rural road. The grades and alignments are poor on this section of the road network.
Section K5 - DPRK -Russian border to Sonbong [30 km] is a 2 lane road in poor condition. As stated earlier there is no road bridge across the Tumen River at the border.

OBSERVATIONS AND COMMENTS

A number of observations were made by the infrastructure team as it traversed Russia and China and from material available on the DPRK. The following points are noted and comments made:

Traffic Growth

Previous reports developed a basis for forecasting traffic demands for the years 2010 and 2020 from population and Gross National Product projections. These traffic forecasts were largely influenced by the concept of an International City located in the Zarubino - Rajin - Hunchun area. It is not now thought that an International City will develop and therefore the traffic forecasts will not materialize to the degree contemplated previously. Rather, it is expected that a broader development in the much larger area encompassed by Chongjin - Yanji - Vladivostok or TREDA will take place, and that the traffic demands will be considerably different and not as concentrated.

The above observation is quite consistent with the Regional Development Strategy report of 1994. It is apparent that Chongjin, Yanji and Vladivostok will continue to be the major cities in TREDA, and that extensive development will occur in the areas of Rajin-Sonbong, Hunchun and Nakhodka-Vostochny. Secondary growth centres will occur in the urbanized areas of Longjin, Tumen, Zarubino and perhaps even in Slavyanka.

Design Standards

Mobility of people and goods will be an important requirement and therefore it is most important that major links in the highway network be upgraded or put into place at an early stage of the area's development. These links must be designed and constructed

to an
appropriate standard to handle the vehicle traffic they will be subjected to. It appears that
China has adopted a load rating standard, and it would be desirable for all three countries to
either agree on it or adopt an alternative as a common standard in the region.
On most of the major highways linking the cities and from the cities to the various ports there is
no restriction on access to the highway. As a result, and this is particularly evident in China,
farm equipment, low powered vehicles, bicycles, and other non motorized vehicles are driving
on the highway surface. This type of activity severely restricts the capacity of the highway and
creates a situation which becomes less and less safe as the volume of either the fast moving
highway traffic or the slower moving traffic increases.
Providing shoulders, wide enough for such non high speed traffic to drive on should alleviate
this situation. This can be well compacted gravel in most cases, but as the volume of such
slower moving traffic increases the shoulders must be paved with asphalt.
Highways' Role
Highways should perform the role of providing mobility for time sensitive movements of people
and goods over the relatively short distances within TREDA.
Highway planners and designers must always keep in mind the overall purpose that the
highway is intended to serve. The main consideration for road classification systems are the
travel demands of the public, land service based on existing and expected future land use and
the overall continuity of the highway network. Illustration 4.1(a) and (b) demonstrates this
theoretically and how demand is translated into a network of differently classified roads.
Road systems are composed of a variety of road types performing two basic services:

- to provide mobility by facilitating vehicle travel between points of origin and destination,
and
- to provide land access.

Access is a fixed requirement, necessary at both ends of any trip. Mobility is provided at
varying levels of service along the trip route. Level of service can incorporate a number of
qualitative descriptive elements such as riding comfort and freedom from speed changes, but
the basic quantifiable factors are operating speed and trip travel time.
Access and mobility are two major considerations in the functional

classification of road
systems (Illustration 4.2). The conflict between serving long distance movement and providing
local access necessitates a variety of functional types. Local facilities are normally short
distance roads which emphasize the land access function. Arterial and freeways are normally
long distance roads providing a high level of mobility for through movement with the freeways
striving for optimum mobility. Collectors offer a balanced service for both functions.
ILLUSTRATIONS 4.1 & 4.2

Year Round Service
Highways, as a source of a good reliable network for its traffic, must be all - weather roads,
meaning that during the winter months the highways must be kept clear for traffic. This will
require the Highway Authorities to ensure they have the staff and equipment to respond to
conditions that develop during such times.
Overloading
The highways should be used with care for their design standards. There was considerable
evidence, in both Russia and China, of trucks loaded beyond the normal loading expected of
such vehicles and for which the roads were designed and built. Such vehicles damage the
surface and eventually the subsurface of any road. To ensure that highway surfaces are not
unduly damaged by over-loaded vehicles it will be necessary to institute some form of weight
monitoring of heavy vehicles. This type of monitoring can be carried out by installing weigh
scales at strategic locations where truck traffic must pass by, such as on the highway between
Kraskino and Hunchun, or by having mobile weigh scales that can be moved to areas where
overloading is most likely to occur. If such a monitoring system is established it must be
supported by a system of imposing penalties for vehicles that are found to weigh in excess of
the allowed limit for that class of vehicle. This may require laws to be established in the
appropriate jurisdiction.
Border Crossings
Where the highway system encounters a border crossing, it currently suffers a severe
Customs and Immigration time delay for both freight and passengers.
RECOMMENDATIONS
Network Regulations and Standards

It is necessary that the three countries coordinate their highway and design standards in order
that the TREDA highways can be looked at as a total system ensuring an efficient, seamless
distribution of freight as well as quick, safe and convenient passenger travel. In this respect
there should be agreement reached on the acceptable load dimensions and weights that will
be permitted on the various parts of the highway network.
One possibility is that a TREDA Highway Commission could be established to collectively and
jointly agree on the regulations and standards that are to be used for design and construction
purposes. This could be convened on a temporary basis, or could take the form of a
conference or workshop sponsored by an organization such as the Tumen River Area
Development Programme (TRADP) or the Committee on Transport and Communications of the
Economic and Social Commission for Asia and the Pacific (ESCAP).
The three TREDA countries should concentrate on reducing the trade impediments introduced
by excessively complicated border crossing procedures. ESCAP can be used as a resource in
researching and developing bilateral trade agreements for handling international trade and in-
bond through shipments.
TREDA Basic Highway Network
In general, the highway system is adequately placed to serve the population centres, but it is
important that it be upgraded to serve the growing needs. These 2 or 4 lane roads must have a
good paved surface and the basic inter-city and ports access network should be as shown in
Table 1.
TABLE 1
 Those sections of highway that do not
currently meet the standard required should be improved to this level. This basic network will
permit people, such as tourists disembarking from boats at Rajin or Zarubino, to travel on
highway bus coaches with relative ease to Hunchun, Yanji and the other tourist areas in this
region. Business people landing at Yanji airport will to be able to travel by automobile or bus to
Tumen, Hunchun, Rajin-Sonbong or Zarubino in a reasonable time. Trucks carrying freight and
time sensitive cargo will have paved roads to or from the ports in Russia and DPRK and
between all major intra-regional origins and destinations.
In the Sea Ports section, it is pointed out that roll-on roll-off shipping is

likely to be a fast
growing mode in the near term. As a result, connecting highways capable of carrying heavily
loaded trucks should be given some priority in the improvement programs.

Zarubino to Vladivostok, the Ferry Option

Until such time as the road from Vladivostok to Zarubino can be completely reconstructed and
paved, and this will probably be several years given the very low traffic that exists currently,
efforts should be made to upgrade the road from Zarubino to Slavyanka. This will permit cars,
highway buses and small trucks to use the existing ferry boat to make the connection from
Slavyanka to Vladivostok.

As an alternative the attractiveness of a car, bus and truck ferry between Vladivostok and
Zarubino should be evaluated. This alternative would permit heavier trucks to roll on to a ferry
at Zarubino and roll off at Vladivostok and vice versa, thus eliminating the need to rebuild the
road between Vladivostok and Slavyanka for a considerable time. The demand for this truck
trip connection is not anticipated to be high and therefore the demand can be met by the ferry
connection.

Analyze Longjin to Yanji

While it appears obvious that 4 lanes from Longjin to Yanji are required a thorough detailed
economical analysis should be undertaken of the cost of engineering, acquiring the necessary
right-of-way and constructing this section of the highway network. Such an analysis should
consider the control of access to this highway and the viability of it being a toll road which
might attract foreign investment to build it.

Road Connections between Mongolia and TREDA

There are a few fair-weather roads to the China and Russia borders in Eastern Mongolia but
these roads are unsuitable to support increased transport needed for mining, agriculture and
tourism development.

The World Bank has recently committed a loan to Mongolia for a Transport Rehabilitation
Project. The road transport component of this project is oriented to motor carriers, spot repairs
and technical assistance rather than road infrastructure. For this reason, funds for studies to
examine the need, feasibility and cost of improved roads in Eastern Mongolia are still needed.

In particular, the development of Eastern Mongolia would be enhanced by good all-weather

road connections to the Russian border from Choybalsan (about 250 km) and to the Chinese
border near Yirshi. The up-grading of the dirt roads to all-weather roads either hard-surfaced or
gravel surfaced will provide connection to the railway networks of the adjacent countries
supplementing the rail connections without gauge-change concerns. Road transport is
probably more suitable than rail for the initial low volumes of traffic to and from the region until
industrial development is better established.

A plan for a direct highway connection from Ulaanbaatar to TREDA has been proposed by
Viatek Ltd. of Finland and this may well be a model for the future. As a next step, a specific
financial and economic feasibility plan would have to be prepared in the format needed by the
development banks to establish whether the project could be funded. The project is a highly
desirable concept for tourism, mining, agriculture and industry in Mongolia but it must now look
for sources of financing for the Chinese segments of road as well as those in Mongolia.

Monitor Traffic Growth

In the mid term (10 years) as development takes place and becomes more predictable it will be
more obvious from traffic build-up on the major routes between Yanji - Tumen-Hunchun and
both Zarubino and Rajin-Sonbong and between Yanji - Longjin - Ssanha - Hoeryong -
Chongjin that capacity of the various highway sections will need to be increased. Careful
monitoring of traffic growth, and the trends of developments and their demands for
transportation, must be put in place.

Responding to Growth

Multi-lane highways of the all-weather type are expensive to maintain and should not be built
before their capacity is required. It is also true that delays caused by congestion and accidents
caused by poorly maintained highways are expensive to both the freight transportation sector
and to the travelling public. Therefore monitoring is most important and the Highway Authority
responsible for the highway network must be in a position to respond at the appropriate time.

Truck Climbing Lanes

Truck climbing lanes should be introduced on steep up-grades to provide a lane for trucks and
other slow-moving vehicles whose speed drops, because of the grade, by more than 15 km/h

below the speed limit. The through uphill lanes as a result are kept free for faster traffic. Truck climbing lanes increase capacity, improve travel times, and reduce accident rates. The width of truck-climbing lanes can be slightly less than the adjacent through lanes, but in no case less than 3.25 m.

Lane Widths

Lane width and condition of the road surface have a significant influence on the safety and comfort of the travelling public. Two lane highways must have adequate vehicle lateral clearance and edge-of-pavement clearance when carrying even moderate volumes of mixed traffic. Problems occur on lanes less than 3.5 m wide and therefore the traffic volume must be quite low before this type of design is acceptable. To provide desirable clearance between trucks, lane widths of 3.75 m should be required and it is generally desirable to maintain this width on higher speed 2-lane roads particularly when the percentage of truck traffic is relatively high. Table 2 suggests the lane widths for various Average Annual Daily Traffic volumes and Design Hour volumes. (The greater width is to be used if they differ.)

TABLE 2

For 4-lane rural roads, where the design speed is 100 km or less lane widths of 3.5m are adequate. In the 4-lane urban sections lane widths of 3.75 m are required where design speeds are over 80 km/h and 3.5 m where the design speed is under 80 km/h.

IMPLEMENTATION PLAN

The primary highway networks should be completed to connect the major ports to the major cities in the TREDA zone as quickly as financing, design and construction can be arranged and carried out.

Highway maintenance management systems should be established in each of the three countries to economically and efficiently maintain the highway system to the required year-round condition. Trained personnel must be retained to design, train and implement such a system.

Vehicle weight monitoring should be established to protect the highway system from overweight trucks and the resultant premature deterioration of the highway. This will require the establishment of laws and the installation and/or purchase of vehicle weight measuring

equipment in addition to the training of staff to operate the equipment and enforce the laws.
Establish a traffic monitoring and planning group in each of countries to provide traffic demand
analysis and forecasting capabilities. Further expansion of capacities in various sections of the
highway network will be based on the predictions of these groups.
Concurrent with the four steps listed above, work towards reducing border crossing
complications.

AIR TRANSPORT NETWORK
OBJECTIVES
In this chapter we will recommend how to best meet the domestic and international air
transport needs of TREDA in such a way as to maximize the benefits of air transportation to
the populations of the signatory countries and minimize the overall investment and operational
costs of the system.
In light of the requirement to take into account the needs, goals and opportunities of the region
in both the long and short terms, this involves:
- linking remote regions to markets;
- improving the accessibility to air transportation and its benefits to the populations of the
region;
- minimizing or mitigating any negative environmental impacts of air transportation;
- promoting links among the signatory countries and other partners in the development of
Northeast Asia in general and TREDA in particular;
- optimizing the use of the existing airport facilities in the region;
- assessing the need and appropriate scope for development of new airport and air
navigation facilities to serve TREDA.

In addition to these general objectives, this report seeks to address the particular question of
improving the air links between Eastern Mongolia and the outside world, especially in the
context of the development of TREDA as both a destination in its own right and a window to
international markets.
EXISTING SITUATION
Airport Locations within TREDA
At present, there are three airports within the TREDA delimited zone which are open to civil
aviation: Vladivostok (Russia), Yanji (China) and Chongjin (DPRK). They are located
peripherally within the TREDA geographic area, in the Northeast, Northwest and Southwest

quadrants, respectively. Map 5.1 illustrates the locations of these airport sites.
The existing airports provide adequate ground access essentially to their own tributary regions
and within their own national territories, leaving some areas of TREDA without the level of
access to air transportation which is necessary to achieve a higher level of economic and
social development. For the most part, these areas lie at the mouth of the Tumen River and in
the Russian "panhandle" area from Khasan to Slavyanka.
MAP 5.1

Existing and Planned Airport Facilities in TREDA
The following paragraphs provide a summary of the existing and planned airport facilities in the
TREDA geographic area, including the sites mentioned in the previous section as well as
proposals for new airports which have been put forward by various interested parties. This
information is based on material published by ICAO, UNDP, UNIDO, Jeppeson Sanderson Inc.
and the civil aviation authorities of the riparian countries. Additional information was provided
by Chinese officials at both local and national levels.
A list of Russian projects in the planning or pre-planning stages is included in Appendix C.
Vladivostok (Russia)
The airport is located 50 km Northeast of the city, near the town of Artem and operates 24
hours per day. It was previously a military base, but now handles both civil and military flights.
The parallel two-runway system (3500 m and 2500 m) with a 07 - 25 (NE-SW) orientation has
no restriction on aircraft types and can accommodate all commercial airliners, including wide-
body jets on long-haul intercontinental flights.
Navigational aids include a non-directional beacon (NDB), precision approach radar (PAR) and
runway approach and edge lighting systems, which support Instrument Landing System (ILS)
approaches on both runways in the 25 direction. Runway 07L-25R is rated for Cat I precision
approaches, (corresponding to a minimum decision height of 60 m and a visibility of 800 m).
Aircraft parking capacity is 22 aircraft stands, including 5 for IL-76 and IL-62 size aircraft.
Mobile buses shuttle passengers to terminal facilities.
The airport handled a reported volume of over 2 million passengers in 1990, but the level of
service in the terminal building is very low, especially with respect to

passenger
accommodations and immigration and customs clearance inspections and
procedures.
The Russian Government has indicated that the plan to modernize
Vladivostok/Artem into an
international-class airport will enable it to accommodate the passenger
traffic demands of the
entire TREDA zone for many years and that the expansion of the airport is not
subject to
limitations.
Being the site of the majority of consulates and representatives of
Asia/Pacific countries and
international organizations in the Far East of Russia, Vladivostok is an
important air passenger
destination in TREDA and a key air service point.
Yanji (China)
Existing airport
The existing airport is located immediately south of Yanji City and is
operated as a joint
military/civil facility. The land is owned by the military, which also
provides the air traffic control
services. The passenger terminal and aircraft parking apron are operated by
the CAAC. The
single runway system was recently repaired and extended to 2600 m and can now
accommodate aircraft up to the size of the MD-82, B-737 and B757 on regional
airline
services. According to the ICAO airport classification system, it is ranked
as a level 4-D facility.
Navigational aids and civilian control tower facilities for control of
terminal airspace will be
required to complement the runway extension and provide for scheduled airline
operations
under adverse meteorological conditions and night operations. According to
information
provided, such facilities will be installed as part of the current airport
improvement program.
Present airport passenger handling facilities are being expanded and upgraded
in order to
accommodate the expected increase in traffic and airline services. A new
16,000 m2 terminal is
being built to meet the needs of both passengers and freight traffic to the
year 2005. The
terminal has been designed to handle 1.4 million passengers/year with a peak
capacity of 700-
900 persons/hour and has taken into consideration the facilities required for
the possibility of
its opening to international traffic; (see Appendix I for a brief
introduction to the Yanji Airport
Terminal Expansion Project).
Proposed new airport
The Chinese authorities of Yanji Municipality, Yanbian Prefecture and Jilin

Province have officially endorsed a plan for the development of a new large-scale airport at Yanji to serve the entire Chinese sector of TREDA, together with a proposed major resort and convention complex at Changbai Mountain. The entire resort and airport development project is proposed as a joint-venture between Korean and Japanese firms and Chinese agencies.

The location of the proposed new airport is approximately 16 km northwest of Yanji City. The choice of this site is related to its accessibility to both the Changbai Mountain and Hunchun areas.

According to studies by the promoters of the project, the selected site has sufficient area to accommodate an international-level hub airport with two independent parallel runways (4000 m and 3600 m) as well as passenger terminals, air cargo facilities and other airport installations required to handle over 60 million annual passengers.

It is expected that the first phase of the new airport will consist of a single runway, passenger terminal building and related works, to be completed by the 2004-2005 horizon, to coincide with the construction of the resort and convention complex and the saturation of the existing airport facilities.

Chongjin (DPRK)

The existing airport has a single runway of 1200 m. The airport was not visited, but previous reports indicate this is a small airport with under 25,000 passengers handled per year. It is not known whether the airport has adequate passenger handling facilities. It has no navigational aids and no facilities for control of terminal airspace.

Tumengang/Rajin-Sonbong (DPRK)

According to UNIDO officials, a dirt airstrip has been constructed near the Russian and Chinese borders at Tumengang (in the northern part of the Rajin-Sonbong Area). The DPRK Government is said to have plans to develop it into a concrete runway with a length of up to 3,600 m. It was not possible to consult any plans of the facility or to visit the site.

The Russian authorities have indicated that there are serious environmental concerns regarding wildlife in this area (particularly bird nesting and migration), and suggest that this is not a practical site for this type of development.

Others

There are a number of other airfields inside TREDA which are now classified

as military
facilities, but which might be used for civil aviation under the appropriate circumstances. Due
to their present military status, information on these facilities was only available from map
sources and, therefore, represents approximations based on scaled estimations of distances
and dimensions.
These include the following:
Russia
Nakhodka: located approximately 20 km northeast of the city and port facilities, with a
runway of about 3,200 m oriented in a NNE-SSW direction; identified by Russian
authorities for possible development in connection with air cargo to/from a proposed
Free Economic Zone.
Vozdvizhenka: located approximately 10-15 km north of the city of Ussurysk, with a
runway of about 3,800 m oriented in a NNE-SSW direction.
Zolotaya Dolina: located approximately 2-5 km northeast of the city of Sparsk Daliniy
and 20 km southwest of Lake Khanka, with a runway of about 4,000 m oriented in a
NE-SW direction.
Khorol: located approximately 5 km northeast of the city of Khorol and 20 km
southeast of Lake Khanka, with a runway of about 4,000 m oriented in a NW-SE direction.
DPRK
Hoeryong
Sanjiyon
Airspace Environment
Operational Responsibilities
The airspace of TREDA and the surrounding areas of Northeast Asia falls under the FIR (flight
information region) administrations of several different countries, as follows:

China	Shenyang FIR
Russia	Vladivostok FIR
DPRK	Pyongyang FIR
ROK	Taegu FIR
Mongolia	Ulaanbaatar FIR

These agencies are responsible for the provision of information for and monitoring of aviation
operations in their respective zones. Map 5.2 provides an illustration of the geographic
delimitations of these zones. There is no special coordinating body or mechanism, as such, at
present to coordinate operations which occur across the national boundaries in TREDA.

MAP 5.2

With respect to the airspace above the three operational airports of the TREDA delimited area, ICAO documentation indicates that controlled terminal airspace exists at Vladivostok; it is not known from the available documentation the extent to which such controlled terminal airspace exists at the other airports in the region. In the case of Yanji, responsibility for air traffic control at the existing airport lies with the military, although there are plans for the eventual introduction of civilian ATC as airline traffic increases.

Restricted Areas / No-Fly Zones

The airspace environment in the TREDA region is characterized by a number of restricted / no-fly zones which constitute constraints for the establishment of new approach and departure flight paths for additional and/or expanded airport facilities. They are summarized in Table 3.

TABLE 3

In addition to these specific zones in the immediate TREDA region, the wider Northeast Asia airspace environment is characterized by other extensive restricted areas, especially in ROK airspace, which result in very circuitous air traffic routings in the region.

International Airways

Air navigation by foreign aircraft in the airspace of each of the countries in the region is restricted to designated international airways only. According to the air navigation charts registered with ICAO, the airways linking TREDA to the outside world are very limited and consist of only the following:

- Airway R22S in the Vladivostok FIR links the DPRK - Russia border with Tekuk, a point in the East Sea (Sea of Japan), approximately 330 km to the east, where it joins several other air routes;
- An extension of the R22S airway in the Pyongyang FIR links the DPRK - Russia border with Kimchaek and Pyongyang;
- Airways R212 and B451 link Vladivostok with the above-mentioned Tekuk point;
- On the Chinese side, there are no designated international airways providing connections to TREDA. The closest such airway in the Shenyang FIR is A588, which links Shenyang, Harbin and Baoxing (on the China - Russia border). Flights to/from

Yanji, therefore, are restricted to Chinese aircraft on air routes which remain to be identified.

Map 5.3 illustrates the pattern of the existing air route structure, as a composite of information from the individual countries' aeronautical charts.

MAP 5.3

Air Services

Regulatory Context

Discussions were held with the CAAC and the Mongolian CAA regarding the relevant provisions of the bilateral air service agreements concerning foreign airline landing rights at Northeast Asian airports in general and those serving TREDA in particular. The results of these discussions are summarized in the following paragraphs.

Russia-China

The Russia-China bilateral was signed on 26 March 1991. Points in the Northeast area of China mentioned specifically as being eligible for scheduled airline services to/from Russian points include:

- Beijing;
- Harbin;
- Shenyang;
- Changchun;
- Tianjin;
- Hohot.

An additional five Northeast Chinese points are mentioned as being eligible for such services, subject to technical considerations:

- Hailar;
- Jiamusi;
- Qiqihar;
- Heihe;
- Suifenhe.

On the Russian side, the agreement mentions:

- Vladivostok;
- Khabarovsk;
- Irkutsk;
- Moscow.

With respect to international regional airline services between cities within TREDA, the agreement does not mention the Yanji-Vladivostok route specifically, but the Chinese authorities indicated that these could be considered as an amendment to the existing bilateral, provided that all technical criteria are met, especially those related to flight safety.

DPRK-China

The bilateral between DPRK and China was signed in November 1993. The route schedule
mentions only the following points:

Beijing (with beyond rights for DPRK carrier);

Pyongyang (with beyond rights for Chinese carrier).

ROK-China

The bilateral between ROK and China was signed on 27 July 1994. It mentions the following
specific relevant points as being eligible for services between the two countries:

Beijing;

Shenyang;

Dalian;

Tianjin;

Seoul.

Although not specifically mentioned in the agreement, the Chinese authorities indicated that
airline services between Seoul and Yanji could be authorized as an amendment provided that
the necessary technical conditions are met.

With respect to the present restrictions on overflights of ROK airspace (see the preceding
section "Airspace Environment"), China is attempting to promote better air access but not at
the risk of exposing passengers to danger. In this regard China is supported by ICAO, which
has specifically requested that ROK take action to permit more direct air navigation in the
region.

Mongolia-China

The present bilateral between Mongolia and China mentions only the following points for
service between the two countries:

Beijing (China);

Hohot (China);

Ulaanbaatar (Mongolia).

So far, China has not acceded to Mongolian requests for the authorization of new air routes
east from Ulaanbaatar to ROK and Japan, which would be necessary for overflights of
Chinese airspace.

Mongolia-Russia

The possibility of designating a Russian intermediate point for service between Ulaanbaatar
and North America was discussed at the last round of talks between Russia and Mongolia.

Other International Agreements

Information available on other relevant bilateral air service agreements registered with ICAO
did not permit a conclusive assessment of the market regulatory context, due to the fact that

the up-to-date documentation is not complete (registration of such agreements is voluntary, not compulsory) and some of the critical agreements with ICAO are only available in the languages of the countries involved.

This being said, with respect to North Pacific scheduled service, the USA - USSR bilateral of 1990 authorized a US carrier to serve Khabarovsk (although Vladivostok enjoyed service in the Fall of 1993) and a USSR carrier to serve Anchorage and San Francisco to/from a point to be designated in Russia. In addition, both countries agreed to give "positive consideration" to applications by charter carriers on an ad hoc basis.

Due to the above-mentioned problem of documentation, it was not possible to ascertain if the Russia - Japan agreement restricts service between the two countries at Vladivostok to the Japanese point of Niigata only, to the exclusion of the larger centres such as Tokyo and Osaka. International access to Yanji or Chongjin was not mentioned specifically in any documentation and neither one is listed yet (Sept. 1994) as a scheduled airline service point in the OAG (Official Airline Guide) or as a customs airport in the AIP (Aeronautical Information Publication) of its respective country.

Domestic Market Regulations

Within China and Russia, the respective governments have taken steps to liberalize the economic regulation of the domestic markets and reduce the protection of the former monopolies of their national carriers and new carriers have sprung up in both countries.

Northeast Asia Airports Network

In theory, TREDA lies in a strategic position, at the crossroads of Northeast Asia and at the centre of a constellation of major regional and intercontinental airports within the range of regional airline service. Table 4 presents a summary of the major airports in the region which are theoretically within this range from the centre of TREDA, ie. approximately 1600 km, or what should be about 2 hours flying time.

TABLE 4

This potential strategic advantage, however, is only theoretical, due to the above-mentioned constraints imposed by the current airspace and regulatory context. At present, TREDA occupies a marginal position in the global and regional airports network and airline service linking TREDA with the outside

world is difficult, inconvenient and time-consuming. The air links to other major cities are generally indirect, passing through other airports in the region and involving complex, circuitous routings.

Airline Services

With respect to scheduled airline services, Vladivostok is the only one of the three operational TREDA airports listed in the OAG (Official Airline Guide) for winter 1994; neither Yanji nor Chongjin appeared in this publication, although Yanji is listed in the summer 1994 Chinese Air Carriers Timetable published by the CAAC.

Scheduled airline service at Vladivostok comprised both regional flights to Russian centres in the Far East, as well as long-haul domestic flights to Moscow and St. Petersburg and international flights to Anchorage (USA) and Niigata (Japan). There are no flights between Vladivostok and the major foreign regional centres of Beijing, Seoul and Tokyo. Scheduled airline service at Yanji includes domestic flights to Beijing, Changchun, Dalian and Shenyang.

Map 5.4 illustrates the current airline services at the existing TREDA airports.

MAP 5.4

Mongolian Aviation Context

Eastern Mongolia

Special mention must be made of the Eastern region of Mongolia, which has been designated by the government as a vital economic special zone and one of the primary motors for the development of the country. The area comprises the "airags" (administrative subdivisions) of Dornod, Khentil and Suhbataar and is centered around Choybalsan.

The government of Mongolia believes that the development of this land-locked region is intimately related to that of TREDA and seeks bilateral and multilateral cooperation with participating TRADP countries. In particular, the Mongolian government places a high priority on the establishment of effective and appropriate air service in this area as a primary factor in achieving its objectives.

Choybalsan Airport

The airport at Choybalsan provides the only direct air link between Eastern Mongolia and the surrounding region. It is a former Soviet military air base which was taken over by the Mongolian government in 1992 and is located approximately 15 km from the

city.
The principal facility of the airport is a 3,000 m by 40 m concrete runway. The airport also
contains a number of rudimentary structures in very poor repair which were built as part of the
military base, but no terminal building or other structures which are appropriate for use as
civilian airport installations. The airport also lacks non-visual landing aids, other air navigation
equipment, reliable communications equipment, radar and a wide range of ground vehicles,
and other support equipment.
At present, scheduled airline service consists of three flights per week to/from Ulaanbaatar by
MIAT (Mongolian Airlines) using Antonov AN-24 aircraft with a seating capacity of 50. There
are occasional charter flights from Japan and Russia.
In order to provide for safe, secure, reliable and convenient air links to the outside world,
Choybalsan airport requires a number of critical improvements related to international aviation
standards and operational efficiency. Although a detailed study would be required in order to
establish a definitive list of the necessary short- and long-term improvements as a function of
the expected traffic, the following represents an indication of the priority items for immediate
implementation:

- widening of the runway from 40 m to 45 m and, eventually, to 60 m in order to accommodate medium-range civilian jet aircraft;
- installation of a VOR/DME for both en-route air navigation purposes (extension of Mongolian airways to Chinese airspace) and as a landing aid at Choybalsan;
- replacement of recycled old Russian telecommunications equipment with up-to-date systems for the purpose of air-ground communications and connections to Ulaanbaatar;
- construction of a small multi-purpose building to house passenger handling facilities, communications and air traffic services, emergency response equipment, air cargo, pilot briefings, airline requirements and airport operations, maintenance and management;
- establishment of an obstacle limitation zoning plan in conformity with ICAO Annex 14 and removal of marking of any obstacles which infringe this zoning.

Ulaanbaatar International Airport
A program of expanding, modernizing and upgrading the international airport at Ulaanbaatar is
underway at an estimated cost of US$39 million, financed by the Asian

Development Bank.
The works will include: rehabilitation, strengthening and expansion of the runway and taxiway;
extension and renovation of the passenger terminal building; construction of an enclosed
hangar for aircraft repairs; an airport vehicle garage; a new control tower/fire hall building; and
modernization of the instrument landing system.

Air Navigation System

With respect to the air route infrastructure, Mongolia occupies a strategic position between the
western part of Russia and Northeast Asia, with connections to Russian east-west airways at
Darno and Nopus at the western end of Mongolia. At present, these routes terminate in
Mongolia, since there is no access via designated airways through Chinese airspace.
Extensions of these routes will require investments in infrastructure such as a VOR/DME for
the Ulaanbaatar-Choybalsan-Sumber-China airway. Mongolia is now establishing a long-range
plan, with assistance from the Asian Development Bank, to upgrade and convert Mongolian
airspace directly to a satellite navigation system, in line with ICAO FANS (Future Air Navigation
Systems) recommendations, with VSAT coverage of the entire country by 1997. This will place
Mongolia in the forefront of the region in terms of the quality of its air navigation infrastructure,
thus enabling the country to take advantage of its geographic position and generate revenues
from overflights. Connections to appropriate airways in Chinese airspace are essential for the
implementation of this plan.

Environmental Considerations

Noise

The extensions of the runway centre-lines at Vladivostok and Yanji intersect the urbanized
areas at Artem and Yanji South respectively. On the basis of map information, the noise from
aircraft using these runways may generate levels of disturbance to the public which will
become a problem, especially as traffic levels increase in the future. The severity of the noise
exposure will depend on a number of factors which cannot be quantified at present, but which
include the type of aircraft being used, the frequency of flights, the time of day of flight
operations, the flight paths being used and the types of flight operation (e.g. airline, military,
pilot training, etc.).

Although we only had the opportunity to observe the current operations and survey local representatives at Yanji in order to determine the severity of this potential problem, it appears that in general the expansion of the facilities and aircraft operations at these sites may conflict with urban development from the point of view of noise exposure.

Soil and Water Contamination

The Vladivostok airport at Artem was built and operated primarily as a Soviet military installation. Although we did not have the opportunity to examine these facilities, experience at similar installations in Eastern Europe leads us to expect significant problems of soil and water contamination at the site.

Wildlife Protection and Bird Hazards

Previous UNDP reports indicate that the Tumen River estuary, the Sonbong-Vladivostok coastal area and some inland zones near Hunchun-Kraskino and North of Slavyanka represent significant wildlife resources which have been earmarked for protection. In particular, Russia is setting up a State Marine Sanctuary and an ornithological reserve in the mouth of the Tumen River. This will have an impact on the range of possible sites for future large-scale airport facilities, e.g. curtailing expansion of the dirt-strip runway near Tumengang, DPRK.

The coastal region of TREDA (approximately from the DPRK - Russia border to Zapovednyy) is indicated on the Russian aeronautical charts (Russian Federation AIP RAC 6-5) as a place of bird concentration. This chart also indicates major bird migratory routes along the entire coastline as well as along a NNE line linking the Tumen River estuary and Khabarovsk, roughly following the orientation of the Ussuri and Amur river valleys.

OBSERVATIONS AND COMMENTS

Passenger Services at Existing Airports

Customs, immigration, health, security, baggage handling and other aspects of passenger and freight processing operations at the existing TREDA airports of Vladivostok, Yanji and Chongjin are deficient compared with those at today's modern airports and constitute an impediment to convenient air access to the region. This is especially true with respect to international inspection services, which are either non-existent (Yanji and Chongjin) or excessively cumbersome (Vladivostok).

Short Term Improvements

In the short term, the region will continue to be served primarily by the existing airports at Vladivostok and Yanji, due to the lack of any other site more accessible to the centres of activity in the region. The planned capital works at these sites will improve the quality of air service to the region and should be encouraged. Furthermore, the impact of these physical improvements could be maximized by combining them with an immediate program dedicated to rationalizing passenger and freight processing (immigration, security, customs, inspections, etc.). This should apply to land border crossings as well as airports and to concepts such as pre-clearance for and/or at other countries, in-bond ground transportation, off-airport check-in, etc.

The Vladivostok and Yanji airport construction works could also be linked to a program of improvements to the ground transportation network in order to extend the benefits of these investments to the widest regional areas.

Growth of Traffic

Information on air traffic forecasts was obtained from published reports by the International Civil Aviation Organization (ICAO) and the International Air Transport Association (IATA):

Outlook for Air Transport to the Year 2001 (ICAO Circular 237-AT/96) 1992;

IATA International Traffic Forecast 93-97.

These publications indicate average annual passenger traffic growth rates in the order of 8% for the Northeast Asia region to the end of the decade. This places the region among the fastest growing areas of the world in terms of average air traffic growth rates for this period.

In addition to this quantitative background, mention should be made of specific air transportation markets which are likely to generate demand growth at the TREDA airports.

The domestic markets (business and leisure) will predominate at all TREDA airports for the foreseeable future; therefore, the prospects for demand growth at each airport will be related to the strength of its domestic market.

Within China, the strong growth of the domestic economy together with the relaxation of internal market regulation, the improvement of airport facilities and the increase in the capacity and number of Chinese airlines is expected to continue to generate

significant traffic growth at Yanji.

Increased trade and other business activity especially with Japan and ROK is expected to generate international business traffic at all TREDA airports.

The presence of the large ethnic Korean population in Yanbian Prefecture is expected to generate business and kinship travel to and from ROK/DPRK and Yanji airport.

Tourism based on the development of a large-scale four-season resort complex at Changbai Mountain is expected to attract passengers through Yanji airport from ROK, Japan and Hong Kong and southern and Eastern China.

It is expected that the existing barriers to air travel between Vladivostok and Yanji (lack of air routes and bilateral air service agreements) will be eliminated and that transborder traffic between these cities will grow significantly.

New Airport Facilities

Although the planned improvements to airport facilities at Vladivostok, Yanji and Tumengang and to the regional highway network should provide most of TREDA with an adequate infrastructure to support effective and convenient air service, there may be a longer-range requirement for new airport facilities in TREDA. This could be due to limitations on the capacity to handle traffic at the existing sites or to inadequate ground access with respect to the total TREDA zone.

Potential of TREDA as an International Air Gateway and Connecting Centre

The long-range role of TREDA as the potential locus for an international air connection centre and gateway to NE Asia must be seen in the context of competition with other airports in the region. The ultimate role of the TREDA airports in Northeast Asia will depend on the capacities of existing airports, decisions made by airlines, competition from other airports, long-term expansion capacity at the new site, the size of the local market, air service rights to/from other cities, etc. In the event that a new airport is planned, the land reserves and zoning restrictions should be such that they would permit eventual expansion of the airport to accommodate long-range aircraft as well as the nature and volume of market demand (i.e. growth of originating, terminating and connecting traffic). This phased approach will make it possible for the airport to eventually play the role of an intercontinental connecting centre if and when sufficient demand

develops.

Airport Authority

Due to the need to seek investment capital from non-governmental sources for the implementation of any required new airport facilities, it may be necessary to create an organization for this purpose, having the appropriate authorization from the participating government(s) as the recognized airport authority for the specific designated area, with the powers to make commercial arrangements with both domestic and foreign organizations for collaboration in the areas of financing, development, and operations. In light of the present lack of institutional integration in TREDA, the creation of such authorities will likely take place separately within each of the countries.

In the future, consideration could be given to the possibility of a multinational airport authority. Such an entity could be devoted specifically to any new TREDA airport but could be designed to include facilities and services for ground and maritime transportation as well. An example of trans-national airport administration exists in the case of the Basel/Mulhouse airport (Switzerland/France). The airport is located in French territory, but operated as a "concession" by a Swiss entity; air traffic control and navigation services are provided by the French Civil Aviation Directorate. A series of agreements, contracts and protocols between the two countries cover arrangements for lease and occupancy of the land, fees for aeronautical services, immigration, customs and health inspections, etc.

In addition to providing the level of airport accessibility and air service required for development of TREDA, airport development could act as a focus for cooperation in the region and provide a tangible demonstration of such cooperation, which would enjoy high visibility on the international scene. The cooperation among the Scandinavian countries in the operation of SAS Airlines provides an example of this.

Minimizing Regulatory Restrictions

As part of the implementation of improved air service to TREDA and in support of its proposed role as a pole of economic and social development, airports serving the region will require access to the widest possible markets. Therefore, the participating governments will have to ensure that regulatory restrictions to market access are minimized and that

the widest airline
traffic rights are available. This could include such innovative features as the establishment of
"open-skies" unrestricted market access to the airport facilities in TREDA.
Northeast Asian Airports Network
It should be noted that the airports beyond Vladivostok, Yanji and Chongjin are too far from
TREDA to provide direct access to the region due to the ground access distances involved,
but form an integral part of the total air transport system. International and regional airports
such as Tokyo, Beijing, Seoul, Osaka, Niigata, Tianjin, Khabarovsk, Shenyang, Harbin,
Changchun, Pyongyang, Ulaanbaatar and Choybalsan should be seen as immediate sources
of potential origin/destination traffic as well as channels for connections to/from the wider world
markets. These airports are also important as potential competition, when considering the
potential long-term prospects for any new connecting centre airport intended to serve TREDA.
Coordination
There does not seem to be a multinational co-operative approach to air transport and the
costly infrastructure and operational considerations that must be addressed to meet evolving
market needs, nor is there a coordinated, integrated plan within TREDA and the surrounding
area designed to satisfy air transport passenger and cargo demand and avoid wasteful
duplication of facilities and investment. As a result, expansion plans for international airports at
both Yanji and Changchun in China, Vladivostok in Russia and Rajin-Sonbong in DPRK should
be carefully coordinated among the three countries.
Although the designation of a single air gateway to NE Asia in TREDA with appropriate
connections to surrounding cities by air, road and rail could help to create an identity for
TREDA vis-a-vis the rest of the world and attract major international carriers, the political reality
is that the current fragmented approach is likely to prevail for the foreseeable future. Although
this may result in higher costs it will not discourage potential foreign investors for the more
promising airport development projects on an individual basis.
Financing
The financing of airport improvement and expansion can be achieved by a variety of
mechanisms, including both government and private sources and both equity and debt

instruments. The worldwide trend over the past decade has been towards innovative involvement of non-governmental sources of capital. Following are a few examples:

Toronto - Terminal 3: construction, financing and management by a private sector consortium (approx. $200 million).

Chicago - United Airlines Terminal: construction, financing and operation by the airline (approx. $400 million).

Athens - New Spata International Airport: RFP organized by Salomon Bros. for construction, financing and operation of a complete new airport in joint venture with Greek airport authority (estimated scale $1 billion +).

Prague - New Passenger Terminal Complex: joint venture between international consortium and Czech Airport Authority to finance, construct, operate a new passenger terminal (approx. $200 million).

In China, government policy in the past few years has been to encourage local authorities to seek foreign investment and lending partners for development of new airports throughout the country, from Shenzhen to Changchun, under a wide variety of arrangements. Response by the foreign investment community has been good.

RECOMMENDATIONS

Improvements to Existing Airports

The improvements to airport facilities and operations which are underway or planned at Yanji and Vladivostok, and other sites in TREDA, should be continued and reinforced in order to provide tangible relief in the short term with respect to the quality of air service to the region.

This will involve the following:

Vladivostok

Passenger terminal to handle 2-3 million annual passengers;

rationalization and streamlining of passenger inspections and processing operations.

Yanji

Passenger terminal to handle 1.4 million annual passengers;

international inspection services;

navaids and ATC facilities to provide minimum Cat I instrument approaches.

Chongjin

Basic passenger facilities to handle passenger loads of small aircraft on local / regional airline services;

navaids and ATC facilities to permit regular scheduled commuter-type regional airline

service.

Evaluate Need for New Airport Facilities

New airport facilities located in TREDA may be required in order to satisfy the demands of the business, tourist, and social air transportation market. A detailed feasibility study should determine the need for such facilities on a regional basis and identify their appropriate role and location as well as the approaches required in order to attract foreign investment.

Specific demand figures were not available, but based on previous reports preliminary TREDA airport volume estimates are one million passengers in the year 2000, and increasing to 20 million passengers in the year 2020 if the area develops into a true international centre.

In response to demand, such an airport would have all necessary facilities to serve major carriers and would be located at the centre of transport, commercial, industrial and telecommunications activities. Terminal facilities, ground access, supporting facilities (e.g. parking lots), a five-star hotel, a telecommunications centre and facilities to assemble and distribute high value goods would also be included.

Support facilities would include the control tower, emergency rescue, refuelling, ground support and global positioning system (GPS) for approaching aircraft and ground movement.

Particular attention will have to be given to environmental considerations in the selection of sites for new airport facilities. In particular, the Bay known locally as Bukhta Ekspeditsh has been designated as an international bird sanctuary. This bay is situated on the East Sea (Sea of Japan) coast of Russia with the town of Kraskino and seaport of Posiet nearby.

Development of an international airport located in the Tumen River Delta, as some reports are suggesting, would therefore represent an environmental risk, since the civil works would be disruptive and most likely one of the approach flight paths would be over this bay.

Integration of Air and Ground Modes

The ground access system linking the existing and planned airports to the centres of population and economic activity in TREDA must be improved and the cross-border facilitation streamlined in order to gain maximum benefits from the existing and planned airport facilities.

Plans for both modes should be integrated to ensure an efficient, convenient

system.
Better highways are keys to success. This would make it more convenient for most passengers
who prefer to go some distance to a major airport with a good choice of departure dates and
times and then reach their destination with a direct flight. Money saved on duplicate airport
facilities can be used to improve road links.
Mechanisms for Airport Management and Cooperation
In order to develop the most efficient use of resources, consideration will have to be given to
national as well as regional interests and benefits. Each country should understand their
respective benefits resulting from collaboration (e.g. Vladivostok airport should have the
perception that it will be fully utilized and is an important component to the total air transport
system). Better collaboration and integration can only be achieved if there are mutual benefits
that are recognized as such for all players within TREDA. Air transport will have a major impact
on regional collaboration and economic integration. This area should be explored as part of an
overall study on air transportation needs for TREDA.
In addition to the construction of additional infrastructure to support air transport needs, there
should be an emphasis on management and operating procedures and technical expertise to
minimize costs and handle passengers in the most effective way possible to facilitate
economic development. We believe that any deficiencies in the current system relate to
management, operation and coordination problems as well as the lack of infrastructure.
Expansion of Air Service Rights to TREDA Airports
In order to create the opportunity for improved airline service to TREDA, the governments will
have to take measures to open up international traffic rights to the TREDA airport(s)
designated for such a "gateway" role. Consideration should be given to some form of "open
skies" or relatively unrestricted environment regarding market access.
TREDA Airport and Air Transportation Study
In light of the above observations, a study of the airport and air transportation requirements of
TREDA should be undertaken immediately. The prime objective of the study is to ensure the
optimum level of air service to the population and the economy of the region, taking into
account the existing facilities and the potential markets of the region. The scope of this study

would include, but not be limited to, the following:

Potential market: analyze the potential market for air passenger and freight services generated by TREDA under specific hypothetical regional development scenarios;

Expand and rationalize the air route network: recommend specific measures to be adopted by all countries in the area (including Mongolia and ROK) to develop more direct and efficient air routes in the region, while ensuring the safety and security of air navigation;

Development of existing airports: determine the appropriate level of development at each existing airport for the first and subsequent phases in consideration of the likely short and long term markets;

Facilitation and ground transportation improvements: analyze and recommend specific measures to improve facilitation, processing and ground transportation to/from Vladivostok and Yanji airports, in order to gain maximum benefits for TREDA;

Integration of transport modes: analyze and propose measures to ensure the optimum linkages between the airports and other modes of transportation, such as ground access and maritime modes (including the possible application of an integrated intermodal sea-air trans-shipment concept for certain categories of air freight) as part of the plans for the study zone;

Multi-national approach: develop a multi-national approach to the integration of airport and air transport services in order to provide convenient air transport services to meet travellers' expectations and give TREDA a competitive and comparative advantage;

Air service treaties: recommend measures to expand the framework of international air service treaties to maximize the opportunities for airline service;

Phased approach: develop a 2-phased strategy to first make the best use of existing airport facilities by improving current operations and land access in the short term while taking steps to ensure the implementation, if required, of new airport facilities with sufficient lead time to meet market demand.

Site selection: subject to political, economic and market considerations and, if appropriate, select a site for the new international airport;

Development plan: elaborate a plan for the expansion of the airports

on the existing
and new sites, to serve as a basis for land acquisition, enactment of zoning and
financing of the required facilities;

Administrative framework: elaborate an administrative framework to facilitate and
encourage private sector investment and involvement in the airport, including the
possibility of creating an independent airport authority with the authorization of the
participating governments;

Financial feasibility: analyze, quantify and demonstrate the financial feasibility and
the socio-economic benefits of the airport's expansion;

Airport authority: elaborate on a model for a multi-national airport authority for
TREDA, in order to harmonize national needs and oversee the best use of existing
airport facilities and decide on the administrative and operational issues and the
expansion and improvement plans to provide the best service at least cost in response
to market demand and competitive factors;

IMPLEMENTATION PLAN

The following represents a preliminary plan outlining actions which will be required to
implement the above recommendations:

Complete the planned short-term improvements to facilities and services at Yanji
and Vladivostok as soon as possible, using the financial arrangements already in place.

Establish a specific mechanism to coordinate the airport and aviation infrastructure
development activities of the three countries in the TREDA region.

It should be noted that the creation of a truly effective instrument of coordination will be
difficult, due to the inevitable competition among the three countries and their local
authorities, as well as their conflicting aspirations for designation as a NE Asia air
gateway/centre.

Execute an in-depth study as described in the section "TREDA Airport and Air
Transportation Study", which would provide an overall airports and aviation
infrastructure development plan for the region, to serve as a guide for actions by each
country, as well as by international agencies.

In order to be effective, this study should be performed under the auspices of an
international coordinating group, as described above. Completion of this study and

agreement among the three countries with respect to its specific conclusions and recommendations will be critical for the attraction of international financing for any major development.

Develop a strategy for the financing of the various specific elements of the overall airports and aviation infrastructure development plan, as described above.

This strategy should cover investments by governments (civil aviation authorities), international organizations and the private sector. It should identify and quantify specific instruments to be created and mechanisms for reimbursement of investments. Taking into account the policies and constraints of the individual countries, it should consider various modalities and combinations of equity and debt financing.

Designate and acquire the land needed for the construction of any new airport installations which may be required and enact the relevant zoning restrictions to ensure long-range expansion and operation of the airports with a minimum of restrictions.

Construct and certify any new airport facilities which may be required, as well as the complementary off-airport infrastructures to be provided by other parties on both groundside and airside.

Train personnel and establish appropriate management structures for the airports in the region, including possible contracts for assistance in airport management by recognized specialists.

Establish the necessary agreements to ensure appropriate market access to the TREDA airports, including traffic rights to domestic points within the riparian countries, as well to international points.

WATER SUPPLY AND WASTE WATER TREATMENT

OBJECTIVES

Of concern to the development of the TREDA and the realization of its economic potential is the planning and maintaining of infrastructure and protecting the environment to foster industrial growth and efficient as well as effective transportation. In the following sections the available information on water and waste water facilities will be outlined as well as described and observations made on the necessary actions required. These will be followed by recommendations on what is needed in order to

complete the
necessary data set so that TREDA's economic development can be achieved.
Once the strategic development plans have been finalized, then the
implementation plans for
the next fifteen to twenty-five years can be formulated.

EXISTING SITUATION

General

The UNDP report entitled "Report on Water Resources Definition Tasks" is the
most
comprehensive report available addressing the various aspects of water
resources throughout
the 33,000 sq. km Tumen Basin. It and its twenty-five annexes give much
useful information
on the basin's water resources, flooding as well as sedimentation problems
and water quality
concerns. What will be covered herewithin are the conditions and concerns
pertaining to the
lower third of the Tumen Basin and the adjacent coastal areas, i.e. the
streams and lands of
TREDA. No information was obtained during the mission on the existing
conditions in the
DPRK sector. The earlier reports covered water supply and waste water in a
general way.

Russia

The Far-Eastern Marine Research, Design and Technology Institute in
Vladivostok provided
tables from one of the Institute's reports covering the resources of the
coastal regions of
Primorsky Krai, Russia. The translated table titles are listed below, and the
tables are given in
Appendix A.

- Fresh Water Supply excluding Industries that are using their own
supplies
- Population Statistics for Coastal Areas

The population centres along the coast west of Vladivostok mainly consists of
the communities
Kraskina, Zarubino and Slavyanka and their environs. The total population has
been estimated
to be 48,000.

Zarubino currently has a population of 18,000 and has a large enough potable
water supply for
a population of 30,000 which is provided by wells located north of the city.
Kraskino and the
nearby port of Posiet both currently obtain their water supplies from wells
situated north of the
communities. It is planned that Zarubino will handle a greatly increasing
volume of cargo and
passengers; hence a large, reliable water supply will have to be obtained.
There is some
consideration of building a water supply reservoir on the Tizankhe River to
meet this demand.

Slavyanka obtains its water supply from the Poyma River, which has the largest drainage area
along the coastal plain from the border with DPRK to the Razdolnaya River.
There are primary water treatment plants at Zarubino, Posiet and Slavyanka, but there is no
sewage treatment.
Nakhodka and its environs has a population of 224,000. The current water demand for the city
is 19,000 m3/day from a reservoir located on the Olga River. The water supply is being treated.
A list of water supply projects in the planning or pre-planning stages is included in Appendix C.
China
The population of Yanji is expected to be between 600,000 and 700,000 by the year 2000. It is
heavily industrialized and currently experiencing an annual twenty percent growth rate.
The City of Yanji's current water demand is 70,000 m3/day. A reservoir is being built (called
Five Reservoir) which will have a volume of 70 million m3. A pipeline from the reservoir to the
city is needed - approximate capital cost 40 million yuan.
A water treatment plant at Yanji with a capacity of 100,000 m3/day is planned. The first phase
with a capacity of 50,000 m3/day is being built.
The current population of Longjing City is 280,000. The city is heavily industrialized with a
domestic water demand of 15,000 m3/day and an industrial water demand of 120,000 m3/day.
Current sewage treatment capacity is 30,000 m3/day.
Construction of a new reservoir at Daxm is being undertaken. The reservoir will have 5 to
10 million m3 of storage, which will increase the water supply by 50,000 m3/day.
OBSERVATIONS AND COMMENTS
Water Supply
For water supply planning only the downstream facilities can be considered with the available
data. The future demands for various municipalities can be estimated, but the determination of
the most feasible sources of the water, except in a few cases such as Hunchun City, will
require field investigations and engineering studies including groundwater exploration and
analysis. Those municipalities within TREDA where estimates are required are given below.
In the Russian Federation: Vostochny, Nakhodka, Vladivostok, Slavyanka, Zarubino, Posiet
and Khasan.
In China: Tumen, Yanji, Longjing, Hunchun and Kahsanby.
In DPRK: Saebyal, Ungsang, Sonbong, Rajin and Chongjin.

In 1992 the population of the greater Hunchun City was 187,000; in 1994, it is nearly 200,000.
There are two separate areas to be considered: one is the Hunchun City; the other is the
newly constructed free economic zone, which has been constructed during the past two years.
There is a water intake to Hunchun City by which approximately 90,000 people were supplies
with water in 1992, 110,000 in 1994 and the projected demand area population is 240,000 in
2010. In 1992, the water demand was 13,000 m3/day, in 1994, it is 25,000 m3/day and the
planned projected demand for 2010 is 100,000 m3/day. The water is currently treated by
filtration.
The 1994 Free Economic Zone's water demand is approximately 5,000 m3/day and the
planned year 2010 demand is 110,000 m3/day. The water is treated, but the method of
treatment is not currently known.
Three dams will be built on the Hunchun River by the City of Hunchun. The Laolong Kow
Reservoir will provide 260 million m3 of live storage and will be used for municipal water
supplies, irrigation, flood control and hydroelectric generation. Construction started in 1993,
and the project will be commissioned in 1998.
It is planned to constructed a dam at Xiasadaogou for water supply, irrigation flood control and
hydroelectricity. It will impound 560 million m3 of water of which 240 million m3 will be live
storage. The third planned dam will be located at Taipinggou. It will impound 106 million m3 of
which 122 million m3 will be live storage.
It has not been decided when the latter two dams will be constructed.
For Hunchun City, the recent water supply system was designed using a domestic water
utilization factor of 220 l/day/capita, hence using this factor the year 2010 water demand will
be 117,000 m3/day. There does not appear to be any hard data on water allocation for
industrial purposes; however, industries that are heavy water users do not appear to be in the
present plans.
To put these water demand statistics into perspective with regard to water supply, the
Hunchun River has a drainage area of 3963 sq. km with an average annual flow of 44 m3/sec
or 3.8 million m3/day. This is more than adequate for the municipal water supplies. However,
this statistic does not take into account the water allocated for irrigation

nor the temporal
distribution of runoff during a year nor the variation from one year to the next.
There are a number of new water supplies being developed and water treatment facilities
being built in TREDA. Throughout the planning horizon to the year 2020, there will be a
threefold increase in TREDA's population with the cities growing faster and having relatively
higher total growths than the smaller communities.
There are three general means by which the urban areas future water demands can be
estimated. One is to use China's gross statistics, the second is to use some current design
statistics for facilities presently being designed or built in China; the third is to relate the water
requirements to those of other countries in Asia with similar climates and economies.
According to Table 33 of the World Development Report, "Investing in Health", The World
Bank, Oxford University Press, 1993, in the 1970-89 period China's average total per capita
fresh water withdrawal is 1266 litres per day. Of this amount 1189 litres is used by industries
and agriculture and 77 litres by households demands. The problem with using these statistics
for the urban centres in TREDA is that the data represents both rural and urban demands.
They do not reflect the high degree of urbanization that will be taking place in the region, and
there is no way to distinguish, with the currently available data, between the agricultural and
industrial demands.
There are some statistics available for China's urban centres both in TREDA and elsewhere.
For example, a water treatment plant is presently being built at Changchun, which will have a
capacity of 200,000 m3/day. The population of the urban area is 1.8 million and there are two
other water treatment plants in the city. In Longjing, the current water demand is
135,000 m3/day and the population is 280,000 - which gives a per capita water demand of 482
litres per day. A limitation of the use of this statistic is that the population stated is current, but
the design parameters are specified to meet the future demands associated with larger
populations and different levels of industrial activity, both of which are unknown.
The TREDA city with the most comprehensive water demand and population projections is

Hunchun. In 1992, 90,000 people were supplied 13,000 m3/day of water or 144 l/day per capita. In 1994, 25,000 m3/day are supplied to 110,000 people - or 227 l/day/capita. The projected 2010 population is 240,000 and the planned water demand is 100,000 m3/day - or 417 l/day/per capita. The problem with these estimates is not all the forecast and design assumptions are known.

Currently financing for water supply as well as water treatment facilities at Wahan and Zunning are under consideration by the World Bank. The design parameters are 120 l/day/capita for the poorer areas and 200 l/day/capita for the more prosperous districts. These statistics are current and do not reflect the increases in per capita water use in the first two decades of the next century, which will be higher with the increase per capita GDP.

From the Korea Electrical Power Corporation Report, it may be learned that the year 2020 per capita GDP in TREDA has been estimated to vary between 13,800 US dollars and 17,500 US dollars depending on the growth scenario and the country segment. Moreover, ROK has a GDP of US$ 12,600 and has a per capital total water demand of 299 l/day. Thus a total water demand of 200 l/day per capita is considered the best estimate for preliminary infrastructure planning - reflecting a value close to 227 l/day being supplied at Hunchun and the World Bank's statistic of 200 l/day for a prosperous region of China - for 1995 urban water demands. The value of 300 l/day/capita based on the ROK statistic will be used for the year 2020 with a linear annual average increase in per capita demand of 1.6 percent.

Considering a per capita water use rate of 300 l/day at the end of the planning horizon, then the total abstraction required for water supplies is approximately three million cubic meters per day or one billion cubic meters per year. This is one seventh the average annual flow of the Tumen River at its mouth. Thus with storage reservoirs near the major cities operating in unison with other objectives (hydroelectric generation and flood control) and with the reuse of water, there is globally more than enough water to supply the needs of the planned population and industrial expansion. At the local level this may not be so as nearby water supplies may not be available and water may have to be transported either from another

tributary or another
basin. The latter could involve transborder water conveyance.
The coastal basins in the Russian sector could provide adequate quantities of water for the
current local populations; however, there is a good possibility that to meet the year 2020
demands in this region of TREDA, more groundwater sources will have to be developed or
water conveyed from a nearby large basin, such as the Hunchun River in China or the
Razdolnaya in Russia.
Waste Water Treatment
There is little waste water treatment currently being undertaken in TREDA. Hunchun, Yanji and
Changchun currently have primary treatment plants, but none provide treatment for the whole
community. By the year 2010 additional treatment facilities for 800,000 cubic meters of waste
water per day will be required in the urban centres.
A sewage treatment plant is planned for Hunchun City. The present system collects wastes
from a 5,000 sq.km. area and conveys it to a 2.3 sq.km. landfill site. The planned sewage
treatment facility, which will collect wastes from both the city and the free economic zone, is
designed for the year 2010 demand of 7,500 m3/sq.km./day. hence in year 2010 the total water
consumption will be 150,000 m3/day. The sewage collection system is designed so that it will
convey 80 percent of the water supplied.
The facility's design parameters are:
Input Sewage Characteristics:
Five Day Bio-oxygen Demand 200 mg/l
Suspended Solids 250 mg/l
TN (Total Nitrogen) 25 mg/l
TP (Total Phosphorus) 10 mg/l
Characteristics of the Plant Output:
Five Day Bio-oxygen Demand 20 mg/l
Suspended Solids 30 mg/l
NH4 - N 15 mg/l
TP (Total phosphorus) 1 mg/l
The capital cost has been estimated to be 20 million US dollars.
Environment
Accelerated Basin Wide Soil Erosion
There will be much forest harvesting, road as well as railway construction and urban
development not only in TREDA but also in its hinterland located in other portions of the
Tumen Basin. All this will cause increased soil erosion throughout the basin and sediment
deposit in the lower river reaches. Steps should be taken to minimize the

amounts of erosion.
Increased Flood Plain Flooding
Because of the expected deforestation and urban development, the flood flows will increase.
Plans should be made via construction of storage dams, stream channelization, flood proofing
and specifying where on flood plain building as well as other structures can be constructed so
that flood induced damages are minimized.
Gravel Mining
There are plans to mine clean coarse sands and gravels from deposits on the flood plains and
from the streambed of the Hunchun River and transport the material to Japan. It is expected
that thirty million cubic meters will be mined. This mining could cause adverse environmental
problems such as land and soil disturbances and changes to the fluvial regime of the stream if
the mining occurs in the streambed.
Floodplain, Shore and Wetland Deterioration in the Tumen River Delta
The floodplains of the Tumen River in its delta and the shorelines of the adjacent coasts of the
East Sea must be protected from development. These areas are environmentally sensitive,
highly biological productive and add to the natural beauty of the region. They have been
designated as environmental protection zones. These enactments should be enforced and the
environment monitored regularly.
Salmon Spawning Rivers
There are numerous small rivers flowing over the coastal plains and hills of Chernyee Gory
between the Tumen River and Vladivostok (there may be others on the DPRK coast of TREDA
also), which are good salmon spawning streams. Action must be taken so that these streams
will not be environmentally damaged due to road as well as railway construction and that any
dams built on the streams for water supplies be equipped with fish ladders.
RECOMMENDATIONS
General
Not only are there plans for greatly increased industrial activities and transportation facilities
throughout TREDA and its hinterland during the next twenty-five years, but also infrastructure
expansion is currently under way. Although a specific facility may be an integral part of an
individual community planned construction, it does not necessarily aid the region's strategic
development in an optimal manner. Hence the overall objective is to plan the regional

infrastructure improvements and expansion so that the strategic development can be realized
in such a way that the industries and transportation networks as well as service facilities can
grow unhampered and the quality of life of the region's citizens will be enhanced.

Planning of Water and Waste Water Facilities

The first step should be to decide whether each community or jurisdiction should do the
planning and be responsible for its own water supply and water as well as waste water
treatment facilities, or should a larger, TREDA-wide organization analyze the current capacities
and distribution systems, project the future demands, undertake regional planning and specify
what needs to be done, where and when.

In the first case it would be advantageous if assistance were given to the communities by
means of population and industrial growth projections, future per capita water demand and
waste water requirement statistics as well as costs. If the more comprehensive approach is
selected, then some or all of the following aspects should be addressed on a regional basis:

- Population growth;
- Per capita water demands;
- Per capita waste water treatment capability;
- Current statistics by municipality on water usage and water losses;
- Most appropriate means of water supply and waste water treatments;
- Water transfer to coastal regions;
- Groundwater resources of the Russian portion;
- Present and future water quality of the lower Tumen River.

Environmental Considerations

Industrialization and growth development will require a great deal of construction to occur and
the operation of such facilities will have daily impacts on the environment. Recognition of the
importance of the environment to the well being of all who live and work in TREDA and its
adjacent areas must be taken into consideration when all such growth is being planned. It is
therefore necessary to evaluate and protect the environment by taking mitigating measures
against the following:

- soil erosion
- flooding
- air pollution
- floodplain, shoreline and wetland deterioration
- bird sanctuary and fish spawning destruction

IMPLEMENTATION PLAN

Once the economic development strategy study is completed and the projections

become
available, the future water supply and waste water treatment facilities can be planned and
costed - either on a municipal or regional basis. To do this the following should be undertaken:

Determine the most appropriate waste water treatment processes;

Undertake a feasibility study of water supply sources for the coastal cities in the
Russian portion;

Particularly for the cities listed in 6.3.1, analyze the municipal water supply as well as
waste water treatment requirements and prepare capital and operating cost projections,
and then develop a staged implementation plan.

ELECTRICAL POWER

OBJECTIVES

Throughout the next twenty-five years, there will be large increases in the electrical energy
demands throughout TREDA for both domestic consumption by larger populations and by the
region's industrial expansions as well as electrification of some of the railway lines. In the
following sections, the projected demands will be covered and the information that was
collected as well as a recently completed feasibility study on efficient power generation for
TREDA will be reviewed. This will be followed by recommendations for studies that should be
undertaken to determine the most feasible mix of electrical generation sources not only to
achieve the demands in various years but also to satisfy these requirements most
economically.

EXISTING SITUATION

General

The report by the Korea Electric Power Corporation gives the 1990 power demand and energy
statistics for TREDA on a country segment basis. These are in Table 5.

TABLE 5

According to this report in 1990 there was a
mix of hydro and thermal capacity in TREDA, which is described in Table 6.

TABLE 6

The majority of TREDA's electrical generation
- in all riparian countries - is from coal-fired thermal plants thereby taking advantage of the
large reserves of lignite. At Hunchun, Chanhua and Jingxin in Jilin Province there is a potential
reserve of 1.2 billion tonnes and an explored reserve of 778 million tonnes. Most of the thermal
plants are coal-fired, although included with the DPRK's sectors statistics

is a 150 mw oil-fired
plant at Chongjin.
The UNDP Water Resources Definitional Tasks Report (1994) briefly covers the hydroelectrical
potential of the 33,000 km2 Tumen River Basin. This report deals with hydroelectric potential of
the whole basin and does not directly address that which could be economically feasible for
electrical energy sources in TREDA. There are currently no hydroelectric plants along the main
stem, although there are plans to develop three or four sites. Statistics on two are given in
Table 7.
TABLE 7
Although there may be economically feasible
hydroelectric sites along the upper reaches of the main stem, most of the potential sites are
located along the basin's first-order tributaries in both China and DPRK. These are outlined in
the Water Resources Definitional Report.
China and Russia deliver power at 50 hertz and DPRK at 60 hertz.
Russia
The Far-Eastern Marine Research, Design and Technology Institute in Vladivostok provided
tables from a study on the resources of the coastal regions of Primorsky Krai. The translated
table titles of the statistics pertaining to energy are listed below and the tables are given in
Appendix A.

- Thermal Heating Loads for Coastal Communities
- Electrical Power Load
- Industrial Consumption of Electricity
- Population Statistics for Coastal Areas

Information on the current electrical usage for the various communities in the Russia portion is
not complete. Vladivostok and its environs are supplied by electrical power as well as hot water
for building heating from a 400-mw coal-fired thermal plant at Vladivostok. At present there is
not enough capacity to meet daily peaks, and load shedding is currently taking place daily.
There are no hydroelectric generation facilities in the Russian portion nor is there any evidence
of any in Primorsky Krai. The province has two billion tonnes of coal reserves.
A list of projects in the planning or pre-planning stages is included in Appendix C.
China
Jilin Province
Jilin Province is currently experiencing a seven percent average annual rate of electrical

demand growth.
Two plants are being built by the Province: They are:
Sonjanghe River Hydroelectric Plant 510 mw - 1997;
Siping Thermal Electric Plant 200 mw - 1996.
Approximately ten percent of the Province's electrical consumption is used for domestic lighting and heating; and ninety percent is used for industrial purposes. There is currently a seven percent per annum annual growth rate of electric consumption. All the electrical power sources in the provinces are interconnected. The province-wide energy prices are 0.34 yuan/kwh for industry as well as commerce and 0.18 yuan/kwh for a household.
Hunchun City
The annual average electrical generation for Hunchun City and its environs is currently 1300 gwh. The electricity is provided by a 200 mw coal-fired plant. The daily peak demand occurs between the hours of 18:00 and 19:00. The average cost of electricity at the bus bar is 0.13 yuan/kwh. The plant is located over a large deposit of lignite (brown coal). Two new units of 300 mw capacity each will be built concurrently with construction commencing in 1995 and commissioning taking place in 1998.
A heating plant with a capacity of 100 to 300 mw is also planned. Total capital cost will be 300,000 to 500,000 million yuan.
There are three multipurpose dams being planned for construction along the Hunchun River.
The Laolong Kow Reservoir and Dam will be used for hydroelectric generation and other benefits. The capacity will be 23 mw, and the average annual generation will be 70 gwh. The dam construction started in 1993, and the project will be commissioned in 1998. There is a planned dam to be constructed farther upstream at Xiasidaogon. The planned capacity is 21 mw, and the average annual generation will be 63 gwh. The third planned dam will be situated at Taipinggow - upstream of the other two. The planned hydroelectric capacity is 6.4 mw, and the average annual generation will be 24 gwh. All three dams will be owned by the City of Hunchun. It has not been decided when the latter two dams will be constructed.
Yanbian Korean Automonous Prefecture
1700 mw of potential hydroelectric capacity has been identified within the Prefecture, with currently 37 mw developed at 34 sites.
Yanji

The City of Yanji's population is 330,000 and it is expected to be between 600,000 and
700,000 by the year 2000. It is heavily industrialized and is currently experiencing a twenty
percent annual growth rate. Its thermal plant currently has a capacity of 50 mw and generates
250 gwh of electricity annually.

Longjing and Yushuchuang

There are two other coal-fired electric plants in Jilin Province. One is located at Longjing, which
has a 50 mw capacity, and the other is at Yushuchuang which has a capacity of 9.8 mw.

The outputs from the Yanji, Longjing and Yushuchuing plants are interconnected. There are
electrical transmission lines to DPRK, but they are not currently used. There is no electrical
interconnection between Jilin and DPRK or Russia.

DPRK

No information was obtained concerning DPRK electrical capabilities during the mission;
however, from The Korea Electric Power Corporation report, the following pertinent statistics
were extracted. The DPRK portion of TREDA currently has three generating plants located at
Sonbong, Chongjin and Sodusoo. The Sonbong plant is oil-fired with two units of 100 mw
each. The Chongjin is coal-fired with one 100 mw unit and another with 50 mw capacity. At
Sodusoo there is a hydroelectric plant with a capacity of 420 mw.

The planned expansion is one unit of 200 mw to be installed at Sonbong and an additional 300
mw thermal plant at Rajin - the construction of both to take place in the 1996-2000 period.

The current electricity prices within the Rajin-Sonbong Free Trade Zone, which is part of the
DPRK portion of TREDA, are: domestic use 0.10 Won/kwh; industrial use 0.12 Won/kwh.

OBSERVATIONS AND COMMENTS

There are three important questions to planning the effective and efficient supply of electrical
energy to TREDA during the next twenty-five years:

1) What are the present electrical capacity and generation statistics?
2) What is the available information on the future electrical demands? and,
3) What information is currently available on the region's potential energy sources?

These topics involve not only the demands in three contiguous regions of the neighbouring
countries, but also on each region's unique mix of hydro and thermal generation with
associated power as well as cost characteristics.

It is difficult when considering TREDA's coal, oil and gas statistics to determine how much is
used for electrical generation and how much for heating buildings directly because in many
communities the buildings are heated from a central heating plant and there does not appear
to be readily available statistics delineating how much electrical energy is used for heating and
other energy requirements.
Besides the three hydroelectric plants identified and planned for the Hunchun River by
Hunchun City, there are three other hydroelectric projects being developed by the provincial
government. The first is the Wanggong Project on the Gaya River, where 25 mw is being
developed. The cost will be 100 million yuan. Construction started in 1985 and the project will
be commissioned in 1994.
Two hydroelectric projects on the Songhua River are planned. The upstream site is at Antu
where 60 mw capacity will be developed with a head of 32 m. A reservoir storage of 60 million
m3 will be created. Construction will start in 1995. The downstream plant will be at Smihu Gov
where 15 mw will be developed. The head will be 38 m, and the reservoir volume will be 250
million cubic meters. This project is currently in the planning stage.
Consideration has been given by DPRK to using natural gas to partly replace oil as an
electrical energy source in its portion of TREDA. Moreover, the City of Yanji is developing a
natural gas supply in a joint venture with a Hong Kong corporation, which will provide 110,000
m3/day.
Yanji's municipal government is working in cooperation with the Korean Power Supply
Company in planning to build another 200 mw plant - the feasibility study is currently
underway.
Besides the projected future TREDA power and generation statistics given in the Korea
Electric Power Corporation Report, similar statistics on power and generation for the year 1990
and the projected year 2000 for the Russian portion of TREDA were provided by the Far-
Eastern Marine Research, Design and Technology Institute in Vladivostok. The applicable total
statistics for the Russian portion of the TREDA are given in Table 8.
TABLE 8
Comparable statistics given in the Korea
Electric Power Corporation Report for the Russian portion of the TREDA are

detailed in Table
9.
TABLE 9

A comparison of the two data sets shows two anomalies. One, even though the power
statistics for 1990 are close to each other - differing by eight percent, the 1990 electrical
generation statistics are far apart - differing by thirty-one percent. Moreover, the Korean report
has both the power demand and annual generation increasing from the year 1990 to year
2000 at an average annual rate of two percent, the Russian Institute's statistics has the
generation requirements increasing at six percent annually and the load demand increasing at
three percent, on the average, throughout the ten-year period.
The Korea Electric Power Corporation derived statistics could be used for initial planning
purposes until more applicable statistics have been determined. They are summarized in Table
10.
TABLE 10
 The information obtained during the mission is
not complete. Data was available for only some cities and towns, and there is confusion on
what is planned in the Yanbian Korean Autonomous Prefecture only and what is planned for
Jilin Province, let alone what are the statistics for other parts of TREDA. Statistics of future
electrical power needs for communities in Russia in the year 2000 were given earlier; however,
most likely they do not represent the future demands of some coastal communities that will
experience rapid growth because of the planned seaport expansions and new transportation
infrastructure.
RECOMMENDATIONS
The identification of economically feasible sources and mixes of electricity for TREDA will
require more comprehensive studies and field investigations than have been undertaken to
date.
The salient considerations are the regions, coal reserves - its volume as well as quality and
costs, the identification of potential hydroelectric sites along with analyses of most promising
economical power developments, projected electrical generation statistics as well as costs and
environmental factors.
Most of the large cities are supplied with electricity and domestic heat from

coal-fired plants
which burn lignite. This is causing high degrees of air pollution in such cities as Hunchun,
Changchun and Yanji. It is recommended that, if economically sound, future electrical
generation should be provided by hydroelectric plants. Also air scrubbers be installed on the
stacks of the coal-fired thermal plants and any future coal-fired thermal plants (and additions if
possible) be built away from and downwind of urban centres.
A comparative cost study of coal-fired thermal electric plants and hydroelectric plants as well
as consideration of other energy sources is needed. The above should be preceded by a
regional power demand and energy generation study.
There is a potential of feasible large, nearby hydroelectric development sites along the
Songhua and Razdolnaya Rivers in Russia north of Vladivostok and this should be studied.
The former stream along with its tributary Wusuki forms the border between China and Russia
throughout most of its course to the sea and could be developed jointly by the two countries.
Concern has been expressed, however, that population density is too high and the agricultural
lands are too valuable to be able to construct any sizeable reservoirs.
Some of the particular studies required are:

Inventory of existing energy consumption in the various jurisdictions by industry and per
capita domestic consumption;

Selection of a suitable mathematical or statistical model to project future electrical
demands from population and industrial statistics;

Feasibility of harnessing the hydroelectric potential of rivers outside TREDA but
contiguous to it and, in particular, border rivers;

The possibility of adopting a common electrical distribution frequency among the three
TREDA districts of the neighbouring countries. This could be all-encompassing, or be
limited to short distances across national borders to serve isolated communities;

The feasibility and benefits of cross border interconnections of electrical distribution
systems.

IMPLEMENTATION PLAN

The following analyses and studies should be undertaken:

Identification of economically feasible sources and mixes of electrical generation;

Identification of the most promising hydroelectric sites.

Establishment of the TREDA's future power and generation

requirements.

Comparative Cost Analysis of coal-fired, oil-fired and hydro generation.

Pre-feasibility study of hydro-electric potential of the Songhu and Radolnaya Rivers in
Russia; and

Establishment of a common electrical distribution frequency throughout all, or parts of
TREDA.

Table 1
Basic Highway Network

SECTION	PAVEMENT	EXISTING/ REQUIRED	WIDTH	TYPE
Russia				
Nakhodka-Vostochny			2 lanes	asphalt
Vladivostok-Nakhodka			2 lanes	asphalt
Slavyanka-Zarubino			2 lanes	asphalt
Zarubino-Kraskino			2 lanes	asphalt
Kraskino-Russia/China Border			2 lanes	asphalt
Kraskino-Russia/DPRK Border			2 lanes	asphalt
		existing		
		required		
		required		
		required		

required
required
China
Russia/China Border-Hunchun
Hunchun-Tumen
Tumen-Yanji
Yanji-Longjin

Longjin-Ssanha
Hunchun-DPRK Border

2 lanes
2 lanes
2 lanes
4 lanes

2 lanes
2 lanes

concrete
asphalt
asphalt
concrete or
asphalt
asphalt
asphalt

existing
existing
existing
required

required
required
DPRK
Chongjin-Hoeryong
Chongjin-Rajin
Rajin-Saebjol
Sonbong-DPRK/Russia Border

2 lanes
2 lanes
2 lanes
2 lanes

asphalt
asphalt
asphalt
asphalt

required

required
required
required

Table 2
Recommended Lane Widths for 2 Lane Highways (M)

Design
Speed
km/h
Average Annual Daily Traffic

4000+
3000-4000
2000-3000
1000-2000
400-1000

Design Hour Volumes

600+
450-600
300-450
150-300
60-150
100
3.75
3.5
3.5
3.5
3.5
90
3.5
3.5
3.5
3.25
3.25
80
3.5

3.5
3.25
3.25
3.25
70
-
3.25
3.25
3.0
3.0
60
-
-
-
3.0
3.0

Table 3
Restricted / No-Fly Zones in the TREDA Region

Country
Designation
Location
Description
Russia
UND 67

UND 68
Sergiyevka
(NW of Vladivostok)
Pushkin
(NW of Vladivostok)
Rocket Launching

Rocket Launching
DPRK
ZK(P)-13
SW of Rajin
not mentioned
China
N.A.
N.A.
N.A.

Table 4
Major Airports Within Theoretical Range of Regional Airline Service

Airport

Country

Air Distance
from the
centre of
TREDA (km)

Theoretical
Time from the
centre of TREDA
(hrs-min)
Existing
Scheduled Direct
Airline Service with
airport in TREDA
Beijing
China
1,190
1h 30m
Yanji
Changchun
China
440
36m
Yanji
Dalian
China
835
1h 8m
Yanji
Harbin
China
450
37m
n.a.
Khabarovsk
Russia
715
57m
Vladivostok
Niigata
Japan
880
1h 13m
Vladivostok
Osaka
Japan
990

1h 20m
none
Pyongyang
DPRK
452
37m
Chongjin
Seoul
ROK
645
49m
none
Shenyang
China
570
46m
Yanji
Tokyo
Japan
1,070
1h 25m
none
Choybalsan
Mongolia
1,350
1h 44m
none

Table 5

POWER DEMAND AND ENERGY

China
DPRK
Russia
Total
Power (mw)
153
331
1207
1671
Energy (gwh)
796
1613
6264
8673

Table 6

AVAILABLE POWER CAPACITY

China
DPRK
Russia
Total
Hydro (mw)
50
420
0
470
Thermal (mw)
360
350
1120
1830
Total (mw)
410
770
1120
2300

Table 7

Project
Drainage
Area
(km2)
Annual
Flow
(m3/s)
Reservoir
Volume
(106 m3)
Capacity

(mw)
Generation

(gwh)
Qingrong
22,379

128
19
23
67
Huangshanpo
23,822
136
83-145
56-80
167-200

Table 8

Year

1990

2000
Average Annual
Increase %
Generation (gwh)
4779
8633
6.1
Power (mw)
1302
1798
3.2
Load Factor
0.42
0.55

Table 9

Generation (gwh)
6264
7653
2.0
Power (mw)
1207
1475
2.0
Load Factor
0.59
0.59

Table 10

Year	Low Growth Scenario #1		High Growth Scenario #2	
	Power (mw)	Energy (gwh)	Power (mw)	Energy (gwh)
1990	1671	8674	1671	8674
1995	1873	9720	1941	10075
2000	2148	11149	2337	12131
2010	3525	18493	3949	20720
2020	6356	33704	9152	48532
Average Growth Rate (1990-2020) %	4.6		4.6	

5.9

5.9

APPENDIX A
SUMMARY TABLES
For some parts of Primorsky Krai

Thermal Heating Loads for Coastal Industries

kcal per hour

Year 1990

Year 2000

Name of City or
Settlement

Industry

Utility

Total

Industry

Utility

Total
City

Vladivostok
1500
1550
3050
2100
2050
4150
Airport
600

330
930
780
440
1220
Nakhodka
450
400
850
630
770
1330
Pertizansk
75
150
225
100
190
290
(Navy Base)
180
165
345
410
300
710
Settlement

Slavyanka
95
45
140
130
80
210
Zarubino
40
25
65
75
80
155
Kraskino
2
13
15

3
24
27
Simolianinovo
7
20
27
10
27
37
Shkotovo
13
20
33
18
27
46
Tavricohianka
47
28
65
55
35
90
Posiet
-
9
9
-
15
15
Livadia
20
30
50
28
42
70

Table A.1
Electrical Power Load

1000 kw

Year 1990

Year 2000

Name of City or
Settlement

Industry

Utility

Total

Industry

Utility

Total
City

Vladivostok
250
333
683
360
440
800
Airport Region
105
61
166
140
81
221
Nakhodka
140
80
220
190
143
333
Pertizansk
65
31
96
140
52
192
Vladivostok (Navy
Base)

55
31
86
80
66
146
Settlement

Slavyanka
25
7
32
40
14
54
Zarubino
9
3
12
25
14
39
Kraskino
2
2
4
3
4
7
Simolianinovo
9
3
12
14
4
18
Shkotovo
1
3
4
2
4
6
Sarrichiaka
7
4

11
10
5
16
Posiet
2
1
3
4
2
6
Livadia
16
6
21
25
6
31

Table A.2
Industrial Consumption of Electricity

Million kwh/Year

Year 1990

Year 2000

Name of City or
Settlement

Industry

Utility

Total

Industry

Utility

Total
City

Vladivostok
1050
1090
2140
1465
1670
3135
Airport Region
300
190
490
435
300
735
Nakhodka
820
250
1070
2200
540
2740
Pertizansk
350
98
448
750
160
910
Vladivostok (Navy
Base)
300
85
385
480
200
680
Settlement

Slavyanka
100
20
120
150
42
192
Zarubino

60
10
70
100
42
142
Kraskino
40
6
46
70
12
82
Simolianinovo
60
9
69
80
14
94
Shkotovo
7
9
16
11
14
25
Sarrichiaka
50
13
63
74
18
92
Posiet
7
3
10
11
6
17
Livadia
65
9
74
80
14
94
Total
3209
1792

5001
5906
3032
8930

Table A.3
Fresh Water Supply excluding Industries that are using their own supplies

1000 m3/day

Year 1990

Year 2000

Name of City or Settlement
Population
Domestic
Misc.
Supply

Total Population
Domestic
Misc.
Supply

Total City

Vladivostok
203.9
161.1
365
286.4
207.7
494.1
Airport Region
33.2

24.8
58
56.2
46.1
102.3
Nakhodka
57.6
49.2
106.8
115.2
68.2
183.4
Pertizansk East of
38.5
18.8
57.3
48.0
23.0
71.0
Vladivostok
(Navy Base)

33.0

36.1

69.1

60.0

62.9

122.9
Settlement

Slavyanka
8.2
4.0
12.2
13.2
6.3
19.3
Zarubino
3.2
3.6
6.8

13.8
11.6
25.4
Kraskino
2.5
0.3
2.0
4.0
0.4
4.4
Simolianinovo
3.6
-
3.6
4.4
-
4.4
Shkotovo
3.7
0.8
4.5
4.4
1.0
5.4
Sarrichiaka
5.3
2.1
7.4
5.7
2.4
8.1
Posiet
1.1
1.2
2.3
1.2
1.8
3.0
Livadia
5.3
2.3
7.6
6.6
3.1
9.7
Total Cities and Large
Settlements

399.1

304.3

708.4

619.1

434.5

1053.6
All Others
16.6
32.4
49.0
23.8
69.9
93.7
Regional Total
415.7
336.7
752.4
642.9
504.4
1147.3

Table A.4
Population for Coastal Areas

1000 people based on statistics available in January 1992

Estimated in 1979

Estimated in 1983

Name of City or
Settlement

1990

2000

1990

2000

1992 Actual
City

Vladivostok
630
760
680
760
674.6
Airport Region
135
150
135
150
70.2
Nakhodka
220
300
180
270
165.5
Pertizansk East of

83

94

-

-

49.9
Vladivostok (Navy
Base)

45

80

60

100

81.5
Settlement

Slavyanka
20
30
20

30
18.1
Zarubino
-
50
10
30
5.3
Kraskino
-
9
6
9
4.6
Simolianinovo
9
13
9
10
7.6
Shkotovo
8
10
9
10
5.7
Sarrichiaka
11
12
13
13
9.8
Posiet
-
3
3
4
2.3
Livadia
11
20
13
15
13.0
Total
1132
1531
1138
1401
1107.5

APPENDIX B
ABBREVIATIONS AND ACRONYMS

While this report attempts to avoid excessive use of letter substitutes, the following are often used.

CIS: Commonwealth of Independent States, covering generally of the former the USSR.

COSCO: The China Ocean Shipping Company, once a state owned semi monopoly, now faced with many private rivals in China.

DPRK: The Democratic Peoples Republic of Korea.

FESCO: The Far East Shipping Company, once the dominant Pacific Basin state owned Russian shipping monopoly, now also faced with many privately owned rivals.

ICD: An Inland Container Depot, or inland port. These are an essential part of any intermodal system. Their chief value lies in the performance of container stuffing/unstuffing away from ports but nearer cargo origins. Inland costs for land labour and support services are lower. Some, but not all, ICDs have official customs inspection services.

NVOCC: A Non Vehicle Owning Common Carrier, a cargo consolidator, usually a forwarder, who negotiates as a shipper with rail, truck, air and water carriers, and presents itself to shippers (usually small and medium) as a carrier. These generally do not own or operate any equipment or terminals, though there are exceptions.

PANAMAX: A type of ship designed to fit exactly through Panama Canal locks measuring 1,000 feet by 110, and allowing 41 ft. water depth or draft (in meters 303 X 33 X 12.4). A POST PANAMAX ship is generally wider and requires shore cranes capable of reaching out by at least 16 ft (4.8 M) more.

TEU: A Twenty Foot Container Equivalent;,a container measuring in feet 20 X 8 X 8 was for many years the world standard. In mature trades these are being replaced by forty foot boxes or FEUs. A TEU generally moves ten revenue tons though variations by trades can be in the order of 25% in either direction. Though confusing (TEUs vs FEUs) the TEU is

still the standard measurement. The eight foot height has grown to 8 ft. 6 in or more and there are now some containers over 40 ft in length. The smaller twenty foot units dominate in the NEARDA area, and this will not soon change.

TSR: The Trans Siberian Railroad running West from the port of Vostochny to the Gulf of Finland ports of St. Petersburgh and Riga (Finland) on the wide Russian gauge, and to many European gauge transfer points such as Brest on the Polish border; not to be confused with a Chinese standard gauge railroad running West from Lianyungang (Yellow Sea) to India, Afghanistan, and other nations of West Asia.

dwt: Deadweight is the weight of cargo, fuel and water that a ship can safely carry. It can vary with the seasons and the route.

ro-ro: Roll-on / roll-off applies to the shipping method where trailers are driven onto and off cargo ships, thus avoiding the need for cranes or other loading devices.

APPENDIX C
RUSSIAN PLANNED PROJECTS
(Provided by the Ministry for External Economic Relations of the Russian Federation)

Sea Ports

Development of the existing sea trade ports:

Extension of Vladivostok sea trade port;
Reconstruction of Nakhodka sea trade port;
Development of the port of Vostochny (complex for transhipment of potassium salt, bunkerage oil depot, grain complex);
Extension of Nakhodka oil port;
Development of sea trade port of Zarubino in the Trinity Bay;
Passenger terminal in the port of Posiet.

Construction of new port complexes in Bays:

Sukhodol near the city Bolshoi Kamen;
Bolshoi Kamen;
Chazhma near Dunai settlement;
Narva near Bezverkhovo settlement.

Elaboration of Feasibility Reports on the construction of new port complexes

in Bays:

Diomod, Ulis in Amursk and Ussuriysk Bays of Vladivostok;
Slavyanka.

Railway Transport Network

Reconstruction and augmentation of railways:
Ugolnaya-Vladivostok;
Uglovaya-Nakhodka;
Ussuriysk-Baranovskiy;
Baranovskiy-Makhalino;
Baranovskiy-Amursk Bay;
Makhalino-Khanka (composit track 1520/1435);
Ussuriysk-Grodekovo (Pogranichniy).

Development of Railway Stations and Junctions:
Grodekovo (Pogranichniy);
Vladivostok Junction;
Nakhodka Junction;
Sukhanovka;
Makhalino.

Construction of New Stations:
Ussuriysk-Sortirovochnaya (Limichevka);
Kamyshovaya (junction with the Station Makhalino near Kraskino settlement).

Augmentation of Railway Accesses to the Sea Ports and Border Crossings:
Sukhanovka - the port of Zarubino;
Yekaterinovka - the port of Vostochniy;
Grodekovo - Suifenhe;
Makhalino - Hunchun.

Prepare Feasibility Reports or Studies on the construction of new railway lines:
By-pass of Artem city in the direction Kiparisovo-Shkotovo;
Straight section of rocade Provalovo-Nadezhdinskaya through Tavrichanka with the bridge in the
Razdolnaya River mouth.

Highway Transport Network

The following plans should be noted:
Motor road A-188 at the section Artem-Nakhodka (reconstruction);
Motor road M-60 at the section Artem-Ussuriysk (reconstruction);
Motor road A-189 at the section Razdolnoye-State border (reconstruction);
Motor road A-184 at the section Ussuriysk-Pogranichniy (reconstruction);

Motor road A-198 at the section Pokrovka-Poltavka (reconstruction);

Speed motor road M-60 - by-pass of Artem city - Nakhodka;

Rocade connection of motor roads M-60 with A-189 with the bridge over the Razdolnaya River mouth;

Speed motor road Sedanka - De-Friza Peninsula - Nadezhdinskaya (second exit from the city of Vladivostok).

Air Transport Network

International terminal in Vladivostok airport;

International cargo airport Zolotaya Dolina in the free economic zone of Nakhodka;

Helipads in Vladivostok, Nakhodka, Zarubino and at border crossings Khasan-Tumen-Ula, Kraskino-Hunchun, Poltavka-Dunnin, Pogranichniy-Suifenhe.

Water Supply

Large water supply projects are:

Water reservoir on the river of Tsukanovka for water supply of the settlements Kraskino and Posyet;

Water reservoir on the river of Gladkaya for water supply of Zarubino;

Water intake in Pushkinsk subterranian water area for water supply of the cities of Vladivostok and Artem;

Vtoroluzhskiy hydrosystem for water supply of towns and settlements of Vladivostok agglomeration;

Water reservoir on the Olga river for water supply of Nakhodka free economic zone.

Electrical Power

The following hydropower stations (HPS) are not included in the TREDA borders, but could be constructed to serve as electrical supply sources for the users in TREDA:

Dalnerechensk in Primorsk territory;
Nizhnenimansk HPS of Urgalsk HPS in Khabarovsk territory;
Bureisk and Nizhnebureisk HPS in Amurskaya region;
Dagmarskaya and Giluyskaya HPS in Amurskaya region.

Thermal power stations located within TREDA borders:

reconstruction of Partizanskaya thermal power station;
reconstruction of Artemovskaya thermal power station;
completion of the construction of Ussuriyskaya thermal power station;
Vladivostokskaya thermal power station no. 3.

Construction of two nuclear power stations (NPS):

Dalnevostochnaya NPS in the Khabarovsk territory;
Primorskaya NPS in Primorskiy territory.

APPENDIX D
Traffic between
Erenhot, Nei Mongol, China
and Zamin Ude, Mongolia
(1,000 tonnes)

Commodity
1992
1995
1996
1997
1998

Export
(from Erenhhot)
Coal

Coke

Petroleum

Steel
10

Metal ore

Non-metal ore

Construction material

Cement

Timber

Fertilizer & Chemicals
10

Grain
30
30
30
30
30

Cotton

Salt

Others
80
79
79
79
78

Total
130
109
109
109
108

Import
(to Erenhot)
Coal

Coke

Petroleum

Steel
80
69
64
61
58

Metal ore
50
50
50
55
55

Non-metal ore

Construction material

Cement

Timber
70

51
46
41
37

Fertilizer & Chemicals
300
420
460
500
540

Grain

Cotton

Salt

Others
70
64
62
60
59

Total
570
654
682
717
749
Total Import & Export

700
763
791

826
857

Traffic between
Manzhouli, Nei Mongol, China
and Zabaykalsh, Chitinskaya Oblast, Russian Federation
(1,000 tonnes)

Commodity
1992
1995
1996
1997
1998

Export
(from Manzhouli)
Coal

Coke
10

Petroleum

Steel

Metal ore

Non-metal ore
140
124
135
146
158

Construction material
10
10
10
10
10

Cement

Timber

Fertilizer & Chemicals

Grain
280
251
242
233
225

Cotton

Salt

Others
360
428
454
482
511

Total
810
813
841
871
904

Import
(to Manzhouli)
Coal

Coke

Petroleum
10
10

10
10
10

Steel
270
256
251
247
242

Metal ore

Non-metal ore

Construction material

Cement
20
19
19
19
19

Timber
50
50
50
50
50

Fertilizer & Chemicals
980
985
990
995

1,000

Grain

Cotton

Salt

Others
420
372
357
342
329

Total
1,750
1,672
1,677
1,663
1,650
Total Import & Export

2,560
2,485
2,518
2,534
2,554

Traffic between
Suifenhe, Heilongjiang, China
and Pogranichniy, Primorsky Krai, Russian Federation
(1,000 tonnes)

Commodity

1992
1995
1996
1997
1998

Export
(from Suifenhe)
Coal

Coke

Petroleum

Steel

Metal ore

Non-metal ore

Construction material
30
39
42
45
48

Cement

Timber

Fertilizer & Chemicals

Grain
80
47
40
34
30

Cotton

Salt

Others
110
148
164
181
200

Total
210
234
246
260
277

Import
(to Suifenhe)
Coal

Coke

Petroleum

Steel
50
62

66
70
74

Metal ore
130
130
130
130
130

Non-metal ore

Construction material

Cement
10
10
10
10
10

Timber
50
31
27
23
20

Fertilizer & Chemicals
420
530
567
603
640

Grain

Cotton

Salt

Others
100
141
159
177
195

Total
760
904
959
1,013
1,069
Total Import & Export

870
1,138
1,205
1,273
1,346

Traffic between
Dandong, Lianoning, China
and Sinuiju, DPRK
(1,000 tonnes)

Commodity
1992
1995
1996
1997
1998

Export
(from Dandong)
Coal
540
463
440
418
397

Coke

Petroleum
10
10
10
10
10

Steel

Metal ore

Non-metal ore
60
90
90
100
100

Construction material

Cement

Timber

Fertilizer & Chemicals

Grain
20
20
20
20
20

Cotton

Salt

Others
90
120
130
140
150

Total
720

703
690
688
687

Import
(to Dandong)
Coal
700
696
647
602
560

Coke

Petroleum

Steel
10
10
10
10
10

Metal ore

Non-metal ore

Construction material

Cement
10

Timber

Fertilizer & Chemicals

Grain

Cotton

Salt

```
Others
10
10
10
10
10

Total
730
716
667
622
580
Total Import & Export

1,450
1,419
1,357
1,310
1,267
```

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