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ENVIRONMENTAL REVIEW FOR TOOLSE PHOSPHORITE DEPOSIT

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KBN ENGINEERING AND APPLIED SCIENCES, INC.

ENVIRONMENTAL REVIEW
FOR
TOOLSE PHOSPHORITE DEPOSIT

Prepared For:

International Fertilizer Development Center
Reservation Road
Muscle Shoals, Alabama 35662

and

U.S. Agency for International Development
Washington, DC

Prepared By:

KBN Engineering and Applied Sciences, Inc.
5680 West Cypress, Suite I
Tampa, Florida 33607

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EXECUTIVE SUMMARY

KBN Engineering and Applied Sciences, Inc. (KBN), was contracted to identify potential environmental issues associated with developing the Toolse phosphorite deposit in north-central Estonia (see Figure 1) and to conduct an initial assessment of the environmental impact of phosphorite-deposit development. Potential impacts were estimated for three phosphorite-development scenarios:

- A mine producing 1.0 million tons of concentrate per year mainly for export,
- A mine producing 0.5 million tons of concentrate per year, and
- A mine producing 0.25 million tons of concentrate per year for Estonia needs.

For the purposes of environmental review, it was assumed that phosphorite mining would be initiated within the current limits of the existing limestone mine located within the viable phosphorite reserves. This occurrence would minimize the impacts to the existing physical, biological, and socioeconomic environment due to the previous mining activity. This occurrence would also have a substantial economic benefit because the limestone mine operations have resulted in the removal of approximately 9 to 15 meters (m) of overburden and limestone.

POTENTIAL ENVIRONMENTAL IMPACTS

The proposed project's impacts were estimated by evaluating the effect construction and operation activities have on the existing physical, biological, and cultural environment.

PHYSICAL ENVIRONMENT

Surface mining will result in the temporary disturbance of the existing surface within the limits of the area to be mined, consuming from 15 to 80 ha/yr depending on the yield of concentrates per hectare and production rates. Alterations to the landscape will also occur in areas planned for the receipt of overburden, including topsoil, and other waste materials, including dictyonema shale, which, at Maardu, has self-ignited upon exposure to the atmosphere. Surface mining impacts to geological resources are anticipated to focus on disruption of the sedimentary deposits that comprise the phosphorite deposit and overburden.

Air impacts from surface mining will occur throughout the duration of mining activity and result from extraction, material handling, and transportation. Additional impacts would occur from

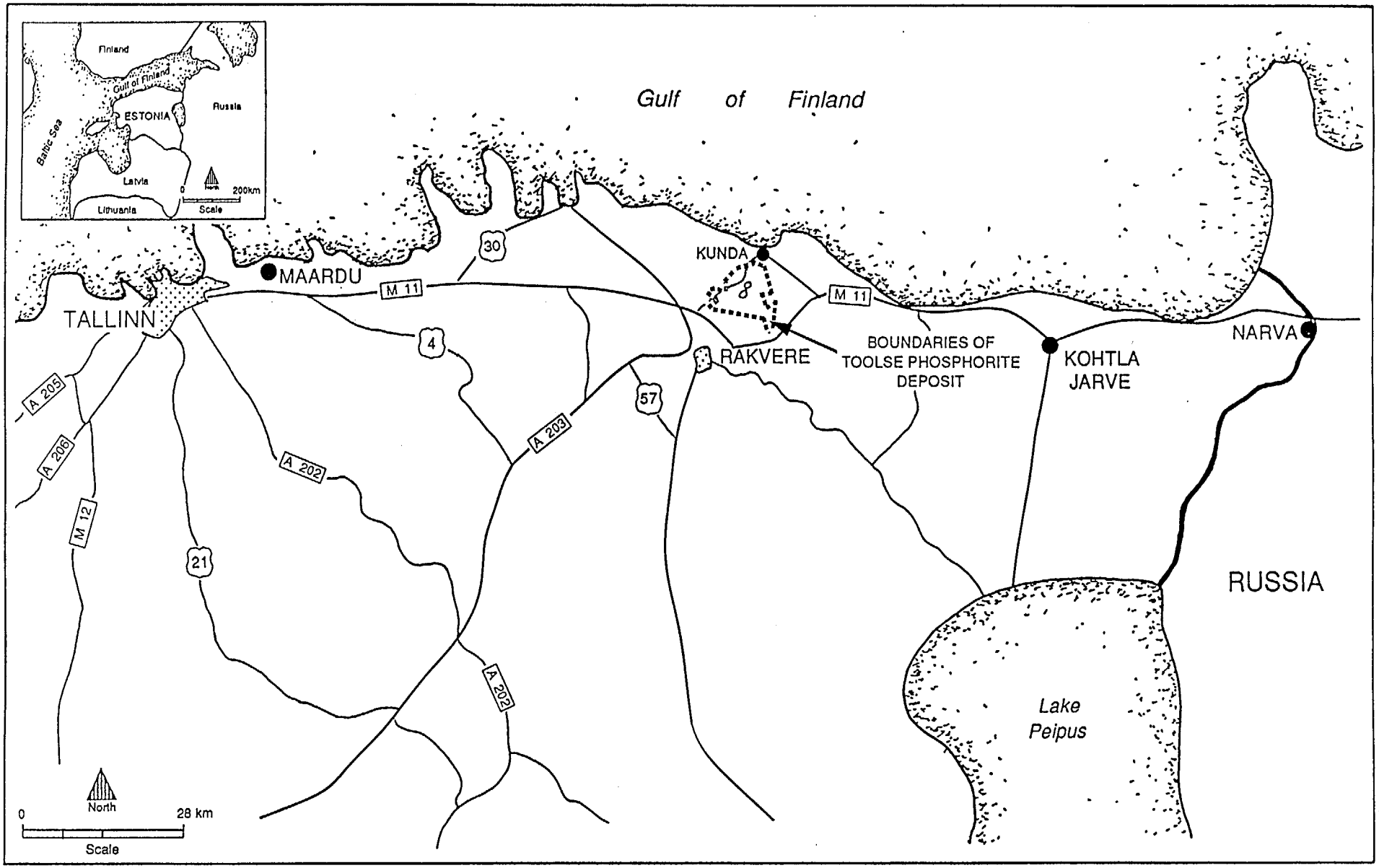

FIGURE 1
LOCATION OF THE TOOLSE PHOSPHORITE DEPOSIT

SOURCE MOSKVA, 1990.

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hydrocarbon emissions associated with mining equipment and transport vehicles. Air impacts could potentially occur as a result of the self-ignition of dictyonema shale, a component of the overburden. Because dictyonema shale combusts when stockpiled and exposed, air impacts from the combustion could pose an environmental as well as human health hazard.

Approximately 15 to 80 ha/yr will be mined in the Kunda, Toolse, and Selja River watersheds. Direct impacts to the rivers may be considerable due to the disruption of soils and vegetation within portions of the watershed, including perennial and seasonal tributaries. Changes to surface water characteristics may also alter the hydroperiod of nearby wetlands. In addition, discharge from stormwater runoff and mine dewatering activities can contaminate local surface waters due to increased levels of turbidity.

Mining of the Toolse phosphorite deposit may also have significant impact on local and regional groundwater resources as a result of dewatering of the active mine area. Current mining impacts have already disrupted water withdrawal at several wells in the limestone mine vicinity. Potential effects on the Pandivere Water Protection Area, located south of the phosphorite deposit, are unknown at this time and must also be addressed. Wetlands may also be impacted by drawdown and subsequent alteration of wetland hydroperiods.

Potential water resource impacts could also occur as a result of the improper management of dictyonema shale. Adverse impacts to water resources from the beneficiation and chemical plants may be considerable since both processes require a substantial volume of water and wastewater discharges from each facility could also degrade the existing water quality of surface water bodies.

BIOLOGICAL ENVIRONMENT

Surface and groundwater impacts may alter the hydrologic regime of nearby vegetation communities in proximity to the mine and support facilities, thereby reducing their function and value as wildlife habitat. Additional adverse impacts are also likely downstream if the flow characteristics and water quality of the rivers is appreciably changed.

Impacts to terrestrial fauna are likely to be moderate since most of the nonforested portion of the deposit is used for agricultural or mining purposes and, therefore, has limited value as wildlife

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habitat. Impacts to aquatic fauna, especially fish and benthic invertebrates, may occur in the affected rivers due to degraded water quality and siltation.

SOCIOECONOMIC ENVIRONMENT

Impacts to demographics will be minor if hiring from the local population is maximized. Impacts will be more substantial if employees are hired from outside the local area, a situation where employees and their families would be required to relocate. Some expropriation of land and improvements and relocation of residents is anticipated.

The small communities of Andja, Jaatma, Kohala, and Ubja are located at or near the limits of the Toolse phosphorite deposit and may be impacted by the proposed mining activity. Onsite areas of agricultural use will be disrupted by the mine. Impacts to community facilities and services can be minimized if proper mine plan, process and support facility siting, and employment programs based on maximizing local hiring are developed. Additional traffic on M-11 could create local congestion during times of peak use and could cause safety concerns at the intersection of the road from Rakvere to Kunda with M-11. Unit trains may also disrupt local and regional traffic patterns.

Development of the proposed mine and processing and support facilities also must not impact the value or use of Lahemma National Park, located 25 km west of the Toolse phosphorite deposit.

The construction and operation of a phosphate mine, beneficiation plant, and possibly a chemical plant will have a positive impact on the local, regional, and national economies. Expenditures for materials, supplies, and services are also considerable; economic benefits would be distributed to numerous types of economic sectors. Impacts to cultural resources will be negligible within the perimeter of the limestone mine due to previous clearing of the surface and the excavation of soils, overburden, and limestone.

Visual impacts from mining the Toolse phosphorite deposit will be limited to areas of public access (rights-of-way) and to farms and nearby communities. Mining activity will be visible from the road between Rakvere and Kunda since this facility bisects the phosphorite deposit. These impacts are not expected to be significant because the area is flat and there is an existing mine and industrial facility near Kunda.

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MITIGATION AND MONITORING

Many of the environmental impacts associated with surface mining, beneficiation, and chemical processing can be mitigated sufficiently to minimize long-term adverse impacts. Environmental monitoring insures the proper implementation of the mine plan and subsequent mitigation activities. A mitigation and monitoring plan should be required and developed to maximize the integration of the mine and processing facilities within the environmental constraints that exist in the vicinity of the Toolse phosphorite deposit and minimize the effects of proposed development on the physical, biological, and socioeconomic environment.

Potential mitigation activities that may be required to successfully mine and process phosphorite in an environmentally acceptable manner include the following:

1. Conduct resource surveys within the project area and its vicinity to assure accurate impact assessment, develop a mine plan that is sensitive to existing environmental conditions and issues, and properly site processing and support facilities.
2. Spray areas cleared of vegetation, with emphasis on roads and other areas subject to vehicle or equipment activity.
3. Provide emission controls for vehicles and equipment, including facilities associated with beneficiation and chemical processing.
4. Conserve water consumption by preparing a water minimization plan that includes water reuse and recycling.
5. Minimize the excavation of aquifers.
6. Control stormwater runoff, use sediment control structures/practices, and revegetate promptly.
7. Treat stormwater runoff and industrial and domestic (sanitary) wastewater.
8. Isolate dictyonema shale and other components of the overburden or processing wastes.
9. Restrict mining and siting of processing and support facilities in floodplains and wetlands.
10. Reclaim portions of the mine to forage and habitat favorable to local wildlife.
11. Prepare a spills plan to facilitate prompt clean up of any accidental spill of raw materials, fuels, or wastes.

12. Manage the off-site traffic requirements associated with employee, equipment, and raw material or product transportation.
13. Relocate any residents and businesses that are located in areas to be mined and provide for all expropriation and resettlement costs and improvements needed in the host community to accommodate the relocated population.
14. Colocate facilities and support facilities.
15. Provide off-site community facilities and services if necessary.
16. Retain local residents for construction and operation employment requirements to the maximum extent practical.
17. Require environmental education/training of key construction and operation managers and employees.
18. Use earth mounds (berms) and vegetative screening.
19. Prepare a public involvement plan to disseminate project information and obtain input from the local population.

Monitoring requirements are likely to be required at Toolse for the following:

1. Ambient air quality and emissions;
2. Workspace air quality and noise levels;
3. Ambient water quality, stormwater runoff, and point-source discharges;
4. Surface water flow;
5. Groundwater drawdown at the mine perimeter;
6. Management and disposal of wastes;
7. Stability of slopes;
8. Restoration of land surface;
9. Revegetation and reclamation;
10. Visual checks for leaks and spills;
11. Expropriation, relocation, and resettlement; and
12. Adequacy of community facilities and services.

Several baseline studies will be required in order to evaluate environmental impacts, support the development of an environmentally acceptable mine plan and assist in the proper siting of processing and support facilities. Recommended baseline studies include:

1. Air resource study to establish local meteorology (wind speed, direction, and rainfall) and ambient air quality.
2. Surface resource study to establish watershed boundaries, stream flows, surface water use, surface water quality, and floodplain limits.
3. Groundwater resource study to verify existing data on location of the aquifers and aquicludes, water level fluctuations, transmissivity, and groundwater quality.
4. Vegetation and wildlife survey to establish the location, extent, and composition of vegetation communities, including wetlands, wildlife habitats, existing wildlife, and the presence of endangered or threatened species.
5. Demographic study to establish the size, ethnic composition, labor skills, and economic well-being of the local population.
6. Land use study to establish the number of homes (and other improvements) and families in the vicinity of the Toolse phosphorite deposit that may require relocation and resettlement.
7. Community facility and service inventory to establish the type and quality of infrastructure and services the local population and nearby cities currently enjoy.
8. Cultural resources study to determine the presence of any archaeological or historic site.

In addition to these baseline studies, a public involvement plan should be prepared and implemented. This plan would be developed to; 1) inform the local residents and Viru County officials of the proposed technical, economic, and environmental studies that will be undertaken; 2) obtain information from the local population that can be integrated into the baseline documentation and impact analysis; 3) obtain input on mine plans and process and support facility plans for refinement of those plans, if necessary; and 4) educate the public on the development of plans and studies, the extent of impacts, the mitigation and monitoring programs required, and the extent of opportunities available to the local labor force.

The social acceptance of the proposed project will hinge, in part, on the accurate and thorough evaluation of physical, biological, and socioeconomic impacts, the use of the local population for construction and operation employment requirements to the maximum extent practical, and a comprehensive public participation and education program. The demonstrated resolution of

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environmental impacts associated with the mine and process facilities at Maardu will also be a factor that will determine the social acceptance of the project.

The economic feasibility of implementation of a comprehensive mitigation and monitoring program is unknown at this time. There are costs associated with the preparation and implementation of these programs. Detailed technical and economic feasibility studies will need to be undertaken before the economic feasibility of environmental mitigation and monitoring can be determined.

1.0 INTRODUCTION

KBN Engineering and Applied Sciences, Inc. (KBN), was contracted by the International Fertilizer Development Center (IFDC) under a U.S. Agency for International Development (USAID) grant to identify potential environmental issues associated with developing the Toolse phosphorite deposit in north-central Estonia (see Figure 1-1) and to conduct an initial assessment of the environmental impact of phosphorite-deposit development. The evaluation was based on a 9-day, fact-finding mission to Estonia to collect relevant information; interviews of various Estonian experts in the technical areas of phosphate mining, beneficiation and chemical processing, and environmental impacts and regulations; visits to the area proposed for mining; and tours of similar nearby mines and plants.

A summary of existing conditions is provided, along with potential impacts that are likely to be expected for three phosphorite-development scenarios:

- A mine producing 1.0 million tons of concentrate per year mainly for export,
- A mine producing 0.5 million tons of concentrate per year for regional needs, and
- A mine producing 0.25 million tons of concentrate per year for Estonia needs.

Potential environmental issues are also identified, based upon existing conditions and the potential impacts identified. Fertilizer production facilities may also be developed in conjunction with any of these phosphate mining scenarios. Mitigation and monitoring opportunities are described, and current environmental regulatory requirements in Estonia are briefly summarized. The final section outlines the general requirements to prepare an environmental assessment and the environmental factors to consider as they relate to the further development of project alternatives.

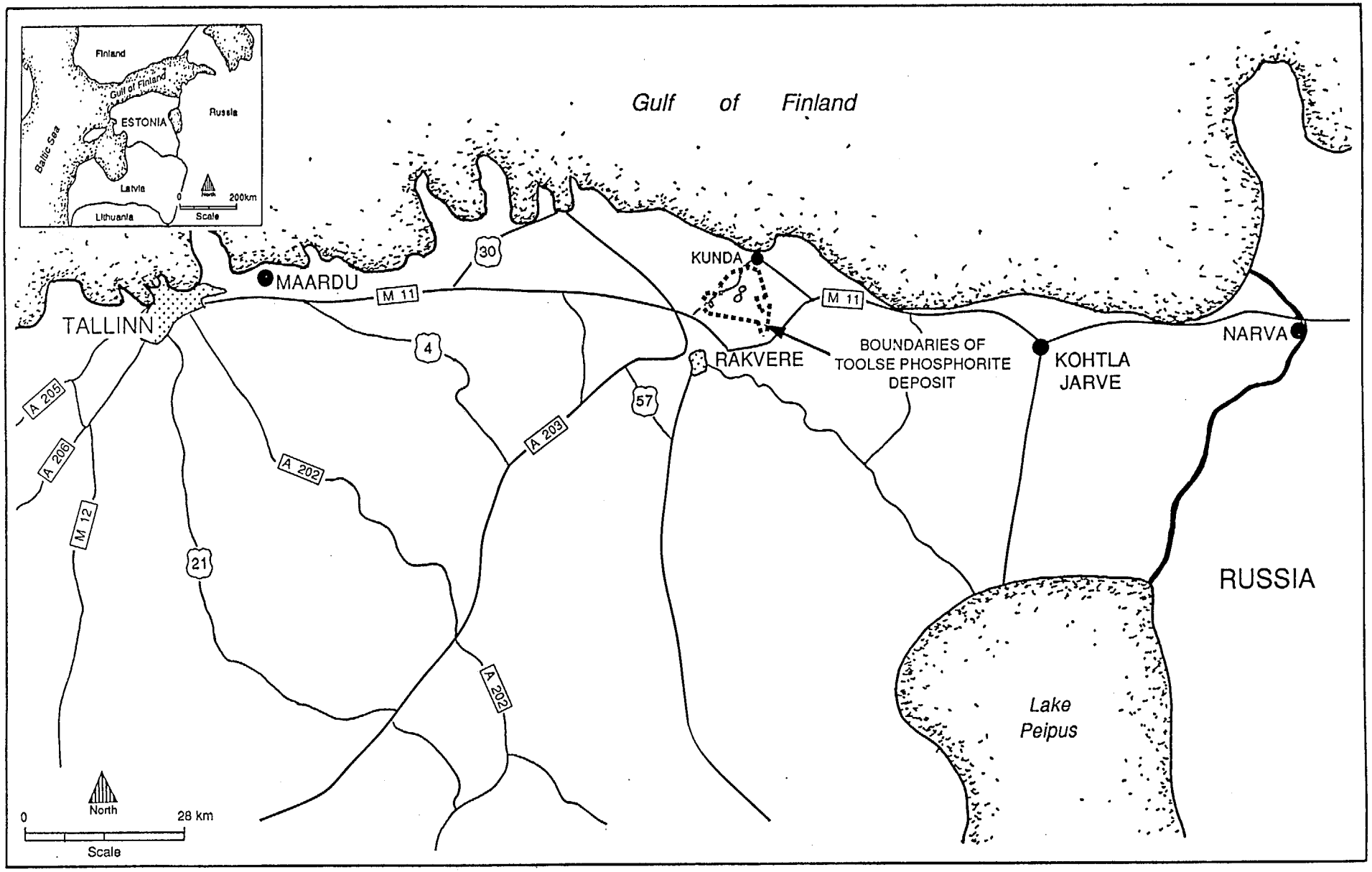

FIGURE 1-1
LOCATION OF THE TOOLSE PHOSPHORITE DEPOSIT

SOURCE MOSKVA, 1990.

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2.0 PROJECT DESCRIPTION

The development of the Toolse phosphorite deposit is currently being considered by the Government of Estonia, Geological Survey of Estonia, the Academy of Sciences of Estonia, and several other associations. Development of a phosphorite fertilizer industry would likely have a significant impact on the local and Estonian economy as it is transformed into a market economy. As a result of a 9-day mission, three development scenarios have been formed for both technical and economic evaluation and preliminary environmental review.

2.1 ALTERNATIVE 1

Alternative 1 consists of developing a mine that would produce 1.0 million tons of concentrate per year mainly for export purposes. Based on IFDL estimates of potential phosphorite reserves, the entire deposit could be exhausted in approximately 18 to 33 years at this rate. Production would consume land at a rate of approximately 60 to 80 hectares per year (ha/yr).

2.2 ALTERNATIVE 2

Alternative 2 consists of developing a mine that would produce 0.5 million tons of concentrate per year for domestic and regional needs. Based on the current IFDL estimate of minable phosphorite reserves, the entire deposit would be exhausted in approximately 36 to 66 years at this rate. Production would consume land at a rate of approximately 30 to 41 ha/yr.

2.3 ALTERNATIVE 3

Alternative 3 consists of developing a mine that would produce 250,000 tons of concentrate per year for domestic purposes. Based upon the current IFDL estimate of minable phosphorite reserves, the entire deposit would be exhausted in approximately 73-132 years and could be confined to the existing limestone mine for approximately 20 years. This rate of production would consume land at a rate of approximately 15 to 21 ha/yr.

For the purposes of environmental review, it was assumed that phosphorite mining would be initiated within the current limits of the existing limestone mine located within the viable phosphorite reserves. This occurrence would minimize the impacts to the existing physical, biological, and socioeconomic environment due to the previous mining activity. This occurrence

would also have a substantial economic benefit because the limestone mine operations have resulted in the removal of approximately 9 to 15 meters (m) of overburden and limestone.

Negotiations are currently underway to rebuild and expand the existing cement plant in Kunda. The expansion would increase the demand for limestone and accelerate development of the existing limestone mine. It is possible that phosphorite mining under Alternatives 2 and 3 could be confined to limestone-mine-impacted areas if future demand for limestone averages approximately 2.5 million tons per year. However, for the purpose of this review, phosphorite mining impacts and issues include both the mining of previously mined land and adjacent unmined areas.

3.0 BASELINE ENVIRONMENTAL CHARACTERIZATION

3.1 PHYSICAL ENVIRONMENT

3.1.1 PHYSIOGRAPHY

The physiography in Estonia is varied and a result of glaciation. Flat to gently rolling plains are predominant in the northern and western portions of the country bordering up to the North Estonian Escarpment, which is located along the coast of the Gulf of Finland (see Figure 1-1). Central Estonia is characterized by undulating moraine plains and numerous bogs. Hillier regions with numerous lakes can be found in the southeast portion of the country. Glacial features including eskers, kames, and drumlins are prominent features in the landscape.

In the vicinity of the Toolse phosphorite deposits, the physiography is characteristic of the flat to gently rolling plains that are characteristic of the northern portions of the country. Land elevations typically range from 40 to 60 meters (m) above sea level. Moderate or greater slopes exist adjacent to nearby rivers and associated tributaries and along the coastal escarpment.

3.1.2 GEOLOGY

Estonia lies on the southern slope of the Fennoscandian shield, a part of the vast East European Plain. A complex of sedimentary rock formations rests upon granite bedrock. The sedimentary rocks underlay quaternary sediments and extend to a depth of approximately 150 m below sea level along the coastline to approximately 190 m below sea level approximately 80 kilometers (km) inland. The inclination of the formations is toward the south-southeast.

The basic geologic column in the vicinity of the Toolse phosphorite deposit is depicted in Figure 3-1. The phosphorite deposit averages 2.9 to 6 m in thickness and is located approximately 5 to 35 m below the surface. The Toolse River is located within the geographic limits of the deposit, and the Toolse River approximately forms the eastern boundary of the deposit. The Selja River is located west of the western limits of the deposit. The quaternary sediments in the buried river valleys associated with these rivers extend to bedrock and, thus, bisect the sedimentary formations depicted in Figure 3-1 that contain phosphorite.

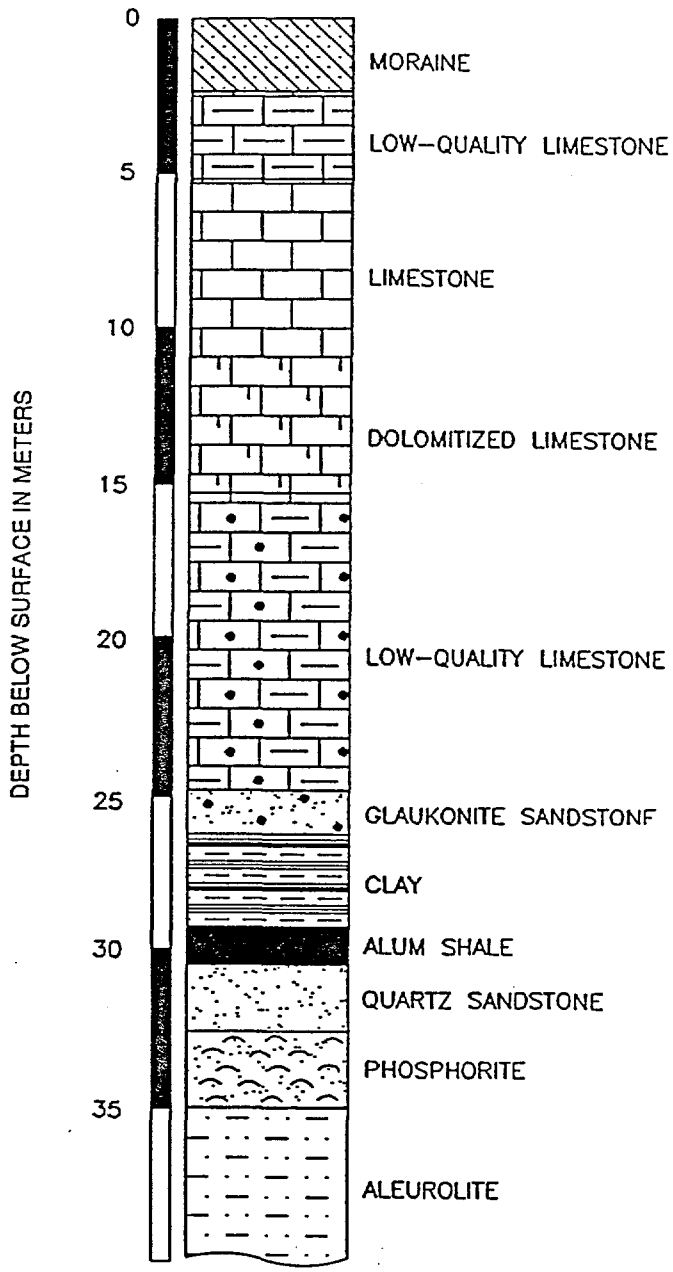

FIGURE 3-1
BASIC GEOLOGIC COLUMN OF
TOOLSE PHOSPHORITE DEPOSIT

SOURCE: TALLINN TECHNICAL UNIVERSITY

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3.1.3 AIR RESOURCES

Estonia has a humid continental climate with cool summers and rainfall distributed throughout the year. Climatic characteristics are moderated by the presence of the Baltic Sea and the Gulf of Finland, causing greater rainfall, warmer winters, and cooler summers. Predominant winds are from the southwest and south. The mean annual temperature is 4.7° centigrade (C) with a mean monthly low temperature of -6.6°C in February and a mean monthly high temperature of 16.3°C in July.

Point source anthropogenic air pollution originates at a number of industrial plants located in or near major cities along the coast. The most substantial emission sources are located in northeast Estonia (near Kohtla-Jarve and Narva, see Figure 1-1) and are associated with thermal power plants fired by locally mined oil shale. Estonia's air quality is also affected by pollution sources located principally in Poland and eastern Germany.

The primary pollutants being emitted from the thermal power plants in northeast Estonia include particulates, sulphur dioxide, and nitrogen oxides. Approximately 90 percent of these pollutants remain within 30 km of the emission stacks.

In the vicinity of the Toolse phosphorite deposit, the primary point source of air pollution is the cement factory located in Kunda, approximately 5 km north of the existing limestone mines that provide raw materials to the factory.

3.1.4 HYDROLOGY

Surface water resources in Estonia are influenced by the most recent glacial retreat. The river and tributary network is dense, but most rivers are small, with only nine rivers exceeding 100 km in length and only three rivers having an average runoff exceeding 50 cubic meters per second (m^3/s). In northern Estonia, many rivers flow in a northerly direction toward the Gulf of Finland. These rivers flow slowly through small valleys except along the coast where the increased relief of the coastal escarpment creates a series of rapids or waterfalls. The Kunda, Toolse, and Selja Rivers, which are located adjacent to or which bisect the Toolse phosphorite deposit (see Figure 3-2), are characteristic of the north Estonia rivers described above.

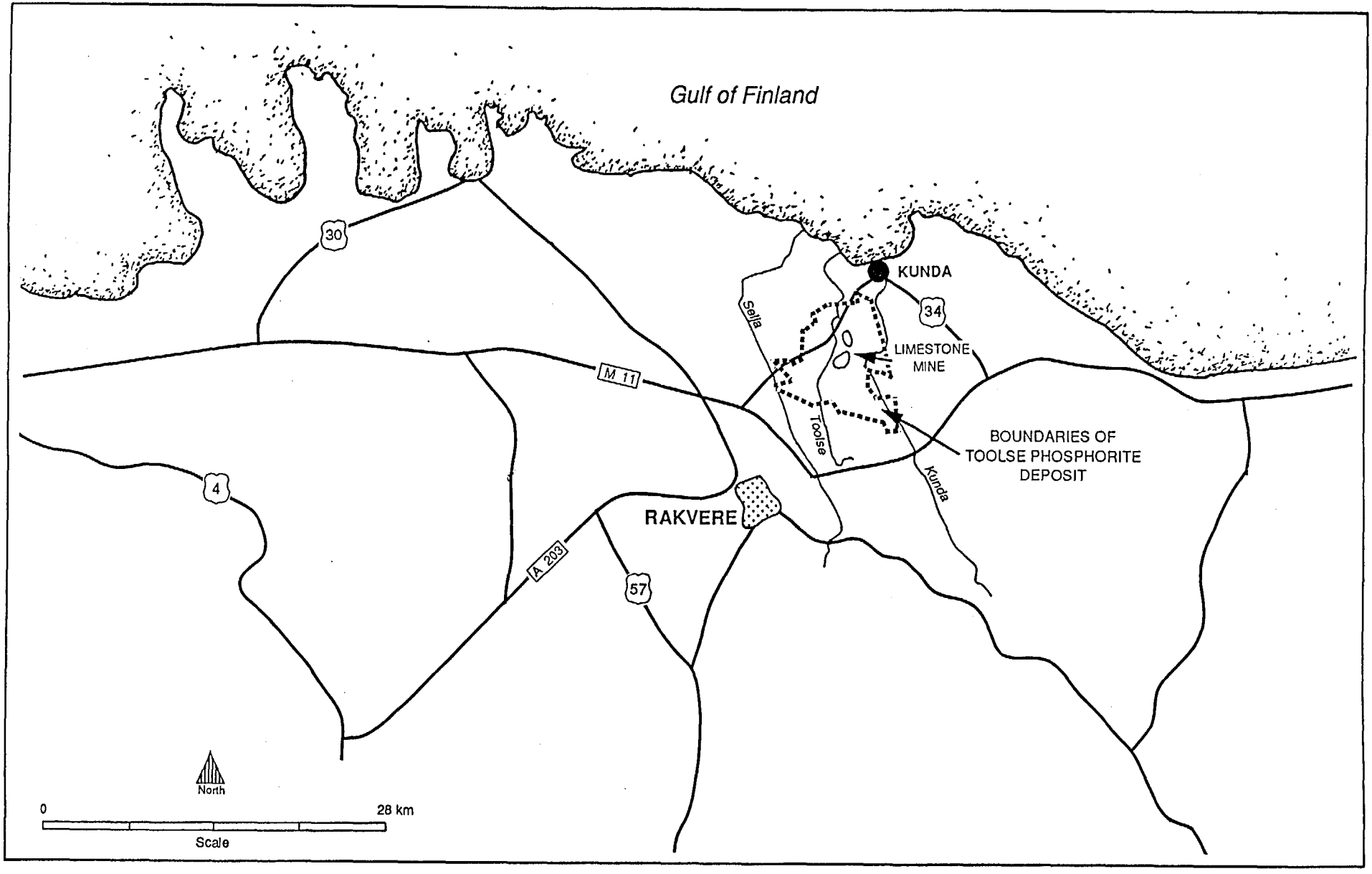

FIGURE 3-2
RIVERS IN THE VICINITY OF THE TOOLSE PHOSPHORITE DEPOSIT

SOURCE: MOSKVA, 1990.

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Lakes are larger and more numerous in south and east Estonia. Many ponds are located throughout the country, especially in the numerous wetlands. A few small ponds are located between the Kunda and Toolse Rivers in the vicinity of the Toolse phosphorite deposit.

Many rivers, lakes, and ponds have been altered by the construction of drainage improvements, dams, and reservoirs. These improvements have resulted in decreased water levels in natural lakes and reduced flows in rivers.

Groundwater resources extend throughout most of Estonia within sedimentary deposits. Groundwater is the principal source of potable water, supplying approximately 66 percent of the demand countrywide. In rural settlements and all towns except Tallinn and Narva, groundwater is the main source of water supply.

In the vicinity of the Toolse phosphorite deposit, there are two main aquifers:

- The surficial Ordovician aquifer averages 15 to 20 m in thickness and is located in the limestones and dolomitized limestones. The aquifer is utilized as a potable water source for individual farms and rural residences.
- The Ordovician-Cambrian aquifer averages 15 m in thickness and is located in deeper sandstones and siltstones.

Both aquifers would be disturbed by mining the Toolse phosphate deposit.

3.2 BIOLOGICAL ENVIRONMENT

3.2.1 FLORA

Estonia comprises a rich and varied diversity of forests, grasslands, and mires. More than 40 percent of the land is covered by forests. A total of 87 native and 500 introduced tree and shrub species have been recorded. The main tree species include pine (*Pinus silsestris*), birch (*Betula pendula* and *B. pubescens*), and spruce (*Picea abies*). Additional and less abundant tree species include speckled alder (*Alnus incana*), aspen (*Populus tremula*), and black adler (*Alnus glutinosa*). Additional deciduous tree species comprise the less abundant deciduous forest communities.

Grasslands comprise more than 24 percent of the land. These vegetation communities include meadows and natural and semi-natural pastures. Mires include fens, bogs, and swamps, and comprise more than 21 percent of the land. Both of these vegetative community types have been disturbed to a significant degree by activities and improvements associated with agriculture. A number of natural areas are currently being preserved or managed under conservation programs instituted by the Estonian government (see Section 3.3.3).

In the past five decades, 14 species of vascular plants and 38 species of lichens in Estonia have become extinct. Another 66 species of vascular plants are listed as endangered.

Natural vegetation communities due not predominate in the area comprising the Toolse phosphorite deposit due to extensive agricultural activity and, to a lesser degree, limestone mining operations. A cursory review of the area was conducted during the initial fact-finding mission.

This review was conducted in winter (late November) and was limited to the main public road and the existing mine. The only vegetative communities observed were forested uplands and wetlands associated with the moderate-width floodplains of the Kunda and Toolse Rivers.

3.2.2 FAUNA

There are 473 species of vertebrates identified in Estonia, including 76 fish, 10 amphibians, 5 reptiles, 316 birds, and 66 mammals. Only a few passerine birds were observed during the cursory review of the existing limestone mine.

3.3 SOCIOECONOMIC ENVIRONMENT

3.3.1 DEMOGRAPHY

The 1990 population estimate for the present day Republic of Estonia is 1,574,955 inhabitants. The population density is 34.8 persons/km^2. The largest city is the capital, Tallinn, with 484,400 inhabitants. The other largest towns include Tartu (115,400), Narva (82,300), and Kohtla-Jarve (76,800).

The ethnic composition of the population includes Estonians (61.5 percent), Russians (30.3 percent), Ukrainians (3.1 percent), Byelorussians (1.8 percent), and others (3.3%). This ethnic composition has substantially changed since pre-World War II, when the ethnic population

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consisted of 88.2 percent Estonians, 8.2 percent Russians, 1.5 percent Germans, and 2.1 percent others. Most of the non-Estonian population lives in northeast Estonia and is engaged in mining, processing, and thermal-power production.

The closest town to the Toolse phosphorite deposit is Kunda, which is located approximately 5 km north of the existing limestone mine. Additional population is located within and adjacent to the phosphorite deposit either in very small communities or as isolated residents/farmsteads. The ethnic composition of the local population is believed to be principally Estonian.

3.3.2 LAND USE

Most of the urban and suburban centers in Estonia are located on or near the north coastline. Two sizeable centers of commerce not located along the north coast are Parnu, located on the coast in southwest Estonia, and Tartu, the second largest city in Estonia located in the east-central portion of the country. The major industrial areas are located in northeast Estonia and in the vicinity of Tallinn, the capital.

The closest town to the Toolse phosphorite deposit is Kunda. Small communities located near the deposit include Andja, Jaatma, Kohala, and Ubja, located north, northeast, and southwest of the existing limestone mine, respectively (see Figure 3-3). These communities are composed primarily of residential dwellings and agricultural buildings.

The predominant land use within and adjacent to the deposit is agriculture. Residential dwellings associated with farmsteads also occur and are scattered throughout the area, primarily along the paved road between Rakvere and Kunda and along unpaved local roads. The existing limestone mine (several individual mine pits) is also located within the eastern portion of the geographic limits of the deposit east of the paved highway and west of Kunda River. Industrial activity occurs within and adjacent to the limestone mine and in the south portion of Kunda, where a large cement plant is located. A rail line extends from Rakvere to Kunda and connects the limestone mine to the cement plant.

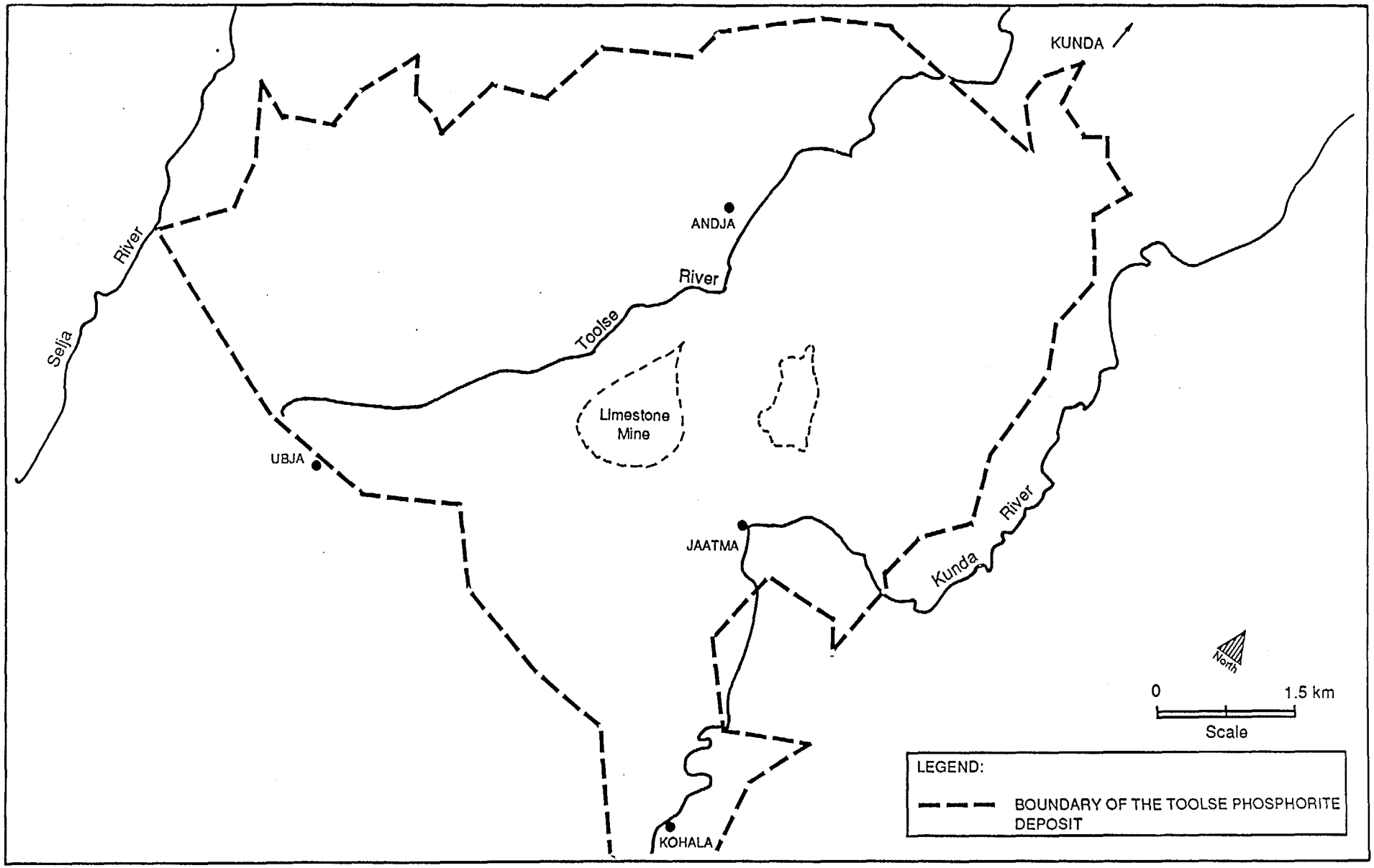

FIGURE 3-3
SETTLEMENTS IN THE VICINITY OF TOOLSE PHOSPHORITE DEPOSIT

SOURCE: TALLINN TECHNICAL UNIVERSITY.

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3.3.3 COMMUNITY FACILITIES AND SERVICES

Community facilities and services are limited in the vicinity of the Toolse phosphorite deposit and are concentrated in the towns of Kunda, approximately 5 km north, and Rakvere, approximately 13 km southwest, of the existing limestone mine.

The principal highways serving the area include M-11, the principal east-west arterial and Route 34, which connects Kunda with M-11 from the east and west (see Figure 3-2). A minor paved arterial highway directly connects Rakvere with Kunda. This highway and Route 34 bisect the deposit. A rail line also bisects the deposit and runs parallel to the minor arterial from the cement plant to Rakvere, where the rail line connects to the main east-west railroad that traverses north Estonia.

Potable water treatment and distribution facilities in the Toolse phosphorite deposit vicinity are unknown at present, although it is likely Rakvere has existing infrastructure. Rakvere also probably has wastewater collection, treatment, and disposal facilities. Water and wastewater facilities are also likely at the cement plant. The small residential communities adjacent to and within the limestone deposit probably have individual systems.

Police, fire, health, and education facilities and services are available in Rakvere, and limited services may be available at Kunda and/or the cement plant. Recreational facilities are also available in the larger towns.

In addition to recreational facilities, regional and national nature protection areas have been established, including a national park and biosphere, and hydrological, landscape, botanical-zoological, ornithological, and geologic reserves. Within proximity to the Toolse phosphorite deposit lie two of these areas: Lahemaa National Park, which consists of 64,400 hectares, and Pandivere Water Protection Area. The phosphorite deposit is centered approximately 25 miles east of the eastern-most boundary of Estonia's only National Park (see Figure 3-4). The phosphorite deposit is near, and possibly adjacent to, the northern border of the water protection area, which generally extends to the south of Rakvere.

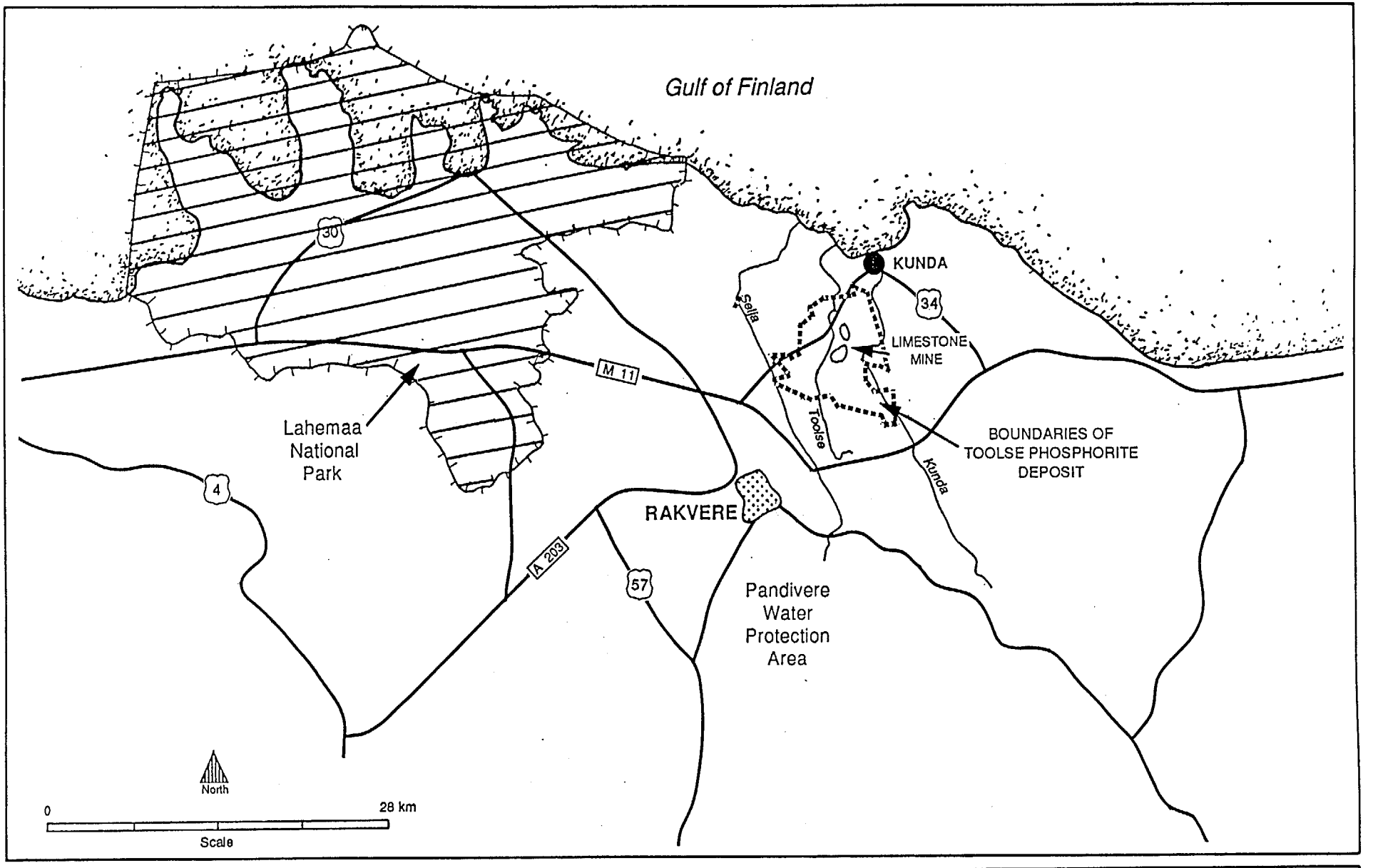

FIGURE 3-4
NATURE PROTECTION AREAS IN THE VICINITY OF TOOLSE PHOSPHORITE DEPOSIT

SOURCES: MOSKVA, 1990; UNITED NATIONS CONFERENCE OF ENVIRONMENTAL DEVELOPMENT.

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3.3.4 ECONOMY

Until recently, the Estonian economy has been isolated from the world market. Manufacturing and construction are the largest sectors of the economy. Textile, clothing, footwear, and foods provide approximately one-half of the industrial output. Mechanical equipment, instruments, power production, and the chemical industry are also important contributors to the national economy. Wood processing and the pulp and paper industries experienced substantial growth during most of the 1980s.

In the vicinity of the Toolse phosphorite deposit, the principal economic activity is limestone and clay mining and cement manufacturing. Agricultural activity is also present.

3.3.5 CULTURAL RESOURCES

During the field review of the existing limestone mine and Toolse phosphorite deposit, a number of farms were observed, including residential structures and farm buildings. Many of the structures were constructed of stone and were very old. These structures have the potential to be historically or architecturally significant.

3.3.6 AESTHETICS

Portions of the Toolse phosphorite deposit are traversed by roads that afford an opportunity for the traveling public to view the landscape within and adjacent to the phosphorite deposit. There are no unique topographic high points nearby where a public vista may be available to view the overall area. Estonia has 14 landscape reserves. The Korvemaa Landscape Reserve is the nearest reserve to the Toolse phosphorite deposit, located approximately 35 km southwest of the central portion of the phosphorite deposit.

4.0 POTENTIAL ENVIRONMENTAL IMPACTS

A proposed project's impacts are determined by evaluating the effect construction and operation activities have on the existing physical, biological, and cultural environment. Until specific mining, beneficiation, and chemical processing plans are developed, impact analyses can only be estimated. The three development scenarios that are, at this stage of evaluation, under consideration include:

- A mine producing 1.0 million tons of concentrate per year mainly for export,
- A mine producing 0.5 million tons of concentrate per year for regional needs, and
- A mine producing 0.25 million tons of concentrate per year for local (Estonia) needs.

Fertilizer production facilities may also be developed to utilize all or a portion of these production scenarios. For the purposes of this initial review, it was assumed that phosphorite mining would be initiated within the current limits of the existing limestone mine and a beneficiation plant would be constructed in the immediate vicinity. The potential for increased limestone production associated with the proposed cement plant expansion and the potential to rebuild the existing phosphorite processing facilities at Maardu were not assumed.

4.1 PHYSICAL ENVIRONMENT

4.1.1 PHYSIOGRAPHY

Surface mining will result in the temporary disturbance of the existing surface within the limits of the area to be mined, consuming from 15 to 80 ha/yr depending on the yield of concentrates per hectare and production rates. Alterations to the landscape will also occur in areas planned for the receipt of overburden, including topsoil, and other waste materials, including dictyonema shale, which, at Maardu, has self-ignited upon exposure to the atmosphere. Mining is anticipated to result in a net increase in area elevations due to the substantial depth of overburden and incomplete recompaction in relation to existing conditions. If mine planning and extraction procedures allow, overburden or solid wastes may be placed in the existing limestone mine. This opportunity, coupled with the flat to rolling topography, will minimize impacts to existing physiography.

Impacts from beneficiation and chemical plants are anticipated to be minor if these facilities are developed and sited in locations that consider physiographic criteria.

4.1.2 GEOLOGY

Surface mining impacts to geological resources are anticipated to focus on disruption of the sedimentary deposits that comprise the phosphorite deposit and overburden. The area is geologically stable from a seismic perspective and karst conditions are present but not well developed. The uppermost aquifer, and potentially the lower aquifer, will be impacted by mining, beneficiation and chemical plant activity; these impacts are described in Section 4.1.4.

Impacts from beneficiation and chemical plants are anticipated to be minor as long as these facilities, if developed, are sited in locations that can support the specific types of buildings and equipment.

4.1.3 AIR RESOURCES

Air impacts from surface mining occur throughout the duration of mining activity and result from extraction, material handling, and transportation. Airborne dust will increase in the vicinity of the mine due to site clearing, excavating, stockpiling, and transportation of the phosphorite matrix, products and supplies, and employees. Impacts would be expected on-site, adjacent to the mine and downwind from the mine. Airborne dust would be more prevalent in the drier months in late summer. Additional impacts would occur from hydrocarbon emissions associated with mining equipment and transport vehicles. Vehicles and equipment would also be a source of noise and vibration. These impacts are expected to be minor due to the rural nature of the mine and vicinity.

Although the population density in the vicinity of the proposed mine is generally sparse, air quality issues may be important due to the historic and current air quality problems associated with the cement plant in Kunda.

Air impacts could potentially occur as a result of the self-ignition of dictyonema shale, a component of the overburden. Because dictyonema shale combusts when stockpiled and exposed, air impacts from the combustion could pose an environmental as well as human health hazard.

4.1.4 HYDROLOGY

Surface mining involves the disruption of the surface and underlying strata. Under the alternatives initially proposed, 15 to 80 ha/yr will be mined in the Kunda, Toolse, and Selja River

watersheds. Direct impacts to the rivers may be considerable due to the disruption of soils and vegetation within portions of the watershed, including perennial and seasonal tributaries. Disruption of natural drainages may result in increased or decreased flows in the rivers. Changes to surface water characteristics may also alter the hydroperiod of nearby wetlands. In addition, discharge from stormwater runoff and mine dewatering activities can contaminate local surface waters due to increased levels of turbidity. Due to the Gulf of Finland's proximity and the local river characteristics, impacts could occur to the Gulf of Finland.

Mining of the Toolse phosphorite deposit may also have significant impact on local and regional groundwater resources. Removal of overburden is expected to require dewatering of the active mine area. Dewatering from the present limestone mine operations (see Figure 4-1) has reduced the elevation of the surficial aquifer (the Ordovician aquifer) table. The cone of depression from this current activity extends from the limestone mine's edge to the Kunda and Selja Rivers. A larger and deeper cone of depression could occur once phosphorite mining begins because it will occur at greater depths. Groundwater impacts potentially could occur in the lower Ordovician-Cambrian aquifer as well. Current mining impacts have already disrupted water withdrawal at several wells in the limestone mine vicinity. Impacts to off-site wells not associated with the proposed project need to be eliminated or mitigated. Potential effects on the Pandivere Water Protection Area are unknown at this time and must also be addressed. Wetlands may also be impacted by drawdown and subsequent alteration of wetland hydroperiods.

Potential water resource impacts could also occur as a result of the improper management of dictyonema shale. Self-ignition of dictyonema shale at Maardu phosphorite mine (see Figure 1-1 for location) resulted in the contamination of both surface water and groundwater by sediments (due in part to ash) and from the leaching of metals from the residue of the shale.

Adverse impacts to water resources from the beneficiation and chemical plants may be considerable since both processes require a substantial volume of water, resulting in aquifer drawdown (groundwater make-up was assumed in lieu of surface water because of the relatively low flow of water in the Kunda, Toolse, and Selja Rivers and the small size of nearby lakes). Wastewater discharges from each facility could also degrade the existing water quality of surface water bodies if pretreatment does not occur and discharges are not minimized and regulated.

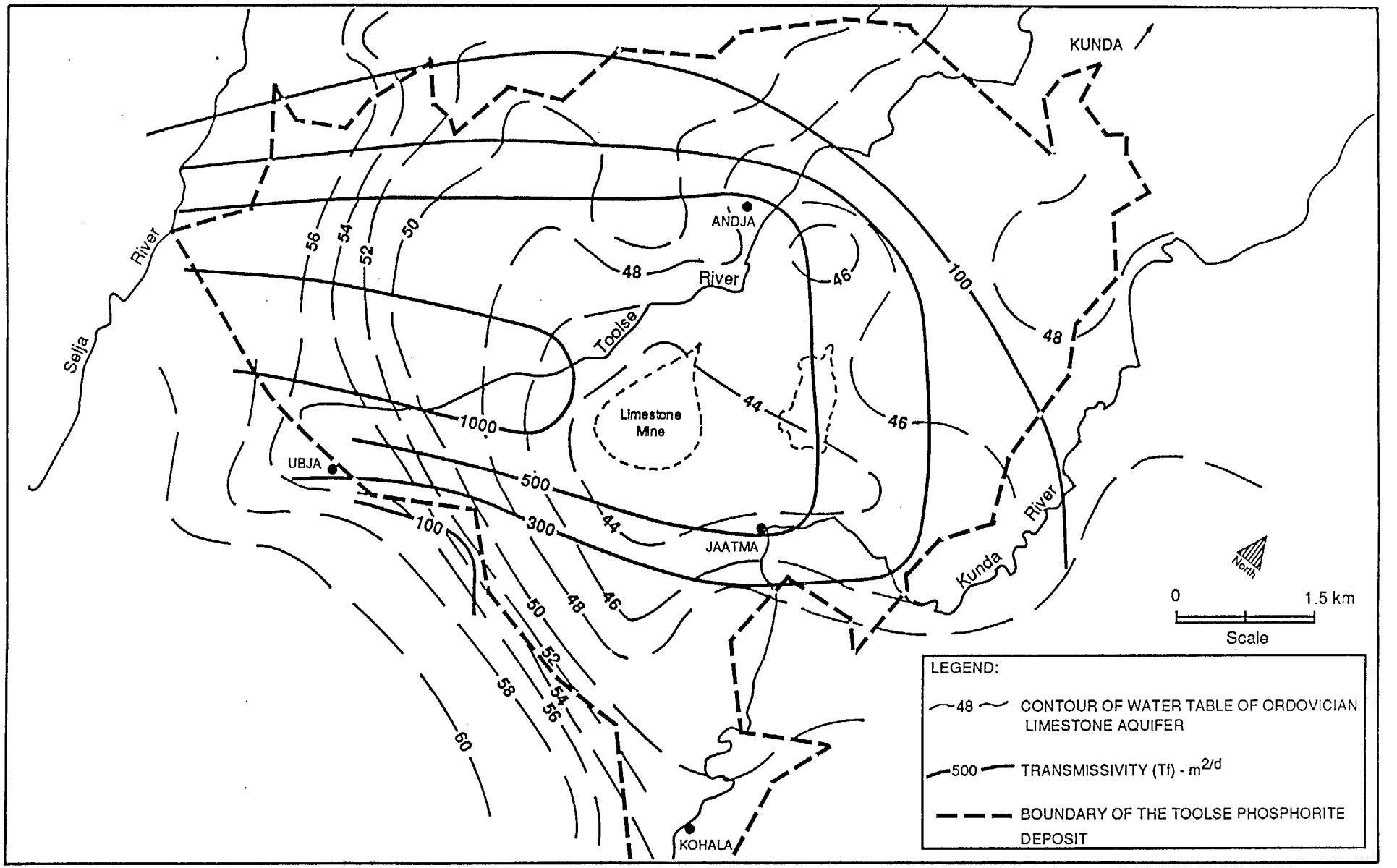

FIGURE 4-1
GROUNDWATER ELEVATION AND TRANSMISSIVITY IN THE VICINITY OF THE TOOLSE PHOSPHORITE DEPOSIT

SOURCE: TALLINN TECHNICAL UNIVERSITY.

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Depending upon the processes developed, wastewater may be acidic or alkaline and may contain impurities found in the phosphate rock, potentially including cadmium, arsenic, and fluorine. Wastewater discharge can be minimized by treatment and recycling of process water. For example, typically more than 90 percent of the water used for processing in the Florida phosphate industry is recycled.

4.2 BIOLOGICAL ENVIRONMENT

4.2.1 FLORA

Most of the land that occupies the Toolse phosphorite deposit has been disturbed previously by agricultural or mining activities. The forested floodplains of the Kunda and Toolse Rivers are expected to remain and will be excluded from the area proposed for mining. Surface and groundwater impacts may, however, alter the hydrologic regime within these and other wetland vegetation communities, thereby reducing their function and value as wildlife habitat. Additional adverse impacts are also likely downstream if the flow characteristics and water quality of the rivers is appreciably changed.

Floral impacts from the development of a beneficiation plant and/or chemical plant are anticipated to be minor if important vegetation communities (i.e., forested areas, wetlands) are avoided when siting these facilities. Impacts from the industrial plants, air, water, and solid waste discharges could be significant if proper pollutant and solid waste treatment and minimization processes are not implemented.

An evaluation of the mine and beneficiation and chemical plants potential impacts to endangered and threatened species will be necessary once the environmental baseline data is established.

4.2.2 FAUNA

Assuming impacts to the forested portions of the mine vicinity are minimized, impacts to terrestrial fauna are likely to be moderate since most of the nonforested portion of the deposit is used for agricultural or mining purposes and, therefore, has limited value as wildlife habitat. Impacts to aquatic fauna, especially fish and benthic invertebrates, may occur in the affected rivers due to degraded water quality and siltation. An evaluation of the mine and beneficiation and chemical plants impacts to endangered and threatened species will be necessary once the environmental baseline data are established.

4.3 SOCIOECONOMIC ENVIRONMENT

4.3.1 DEMOGRAPHY

The proposed mine and beneficiation plant are expected to require several hundred to more than 1,000 total employees and related service personnel depending on the production scenario and of fertilizer plants are developed in conjunction with phosphate mining. The smaller employment scenario represents the smaller production assumption identified in Alternative 3 (Section 2.3) and the larger estimates represent the increased production associated with Alternative 1.

Impacts to demographics will be minor if hiring from the local population is maximized. Impacts will be more substantial if employees are hired from outside the local area, a situation where employees and their families would be required to relocate.

Some expropriation of land and improvements and relocation of residents is anticipated although the number of families directly affected by planned mining activities will not be known until a mining plan is prepared and a detailed land use survey is conducted. The total number of people affected is expected to be moderate; the area is populated by a few residential areas and scattered farmsteads. An expropriation and resettlement plan is assumed to be necessary.

4.3.2 LAND USE

The small communities of Andja, Jaatma, Kohala, and Ubja are located at or near the limits of the Toolse phosphorite deposit and may be impacted by the proposed mining activity. Onsite areas of agricultural use will be disrupted by the mine. Impacts to agriculture are likely to be minimized by reclamation efforts that will restore portions of the area to agricultural use. Impact minimization will be achieved if type-for-type restoration is achieved, i.e., row crops are replaced with an area capable of supporting future row-crop agriculture. Impacts to land use from the construction and operation of the beneficiation and chemical plants will be minimal as long as their location considers adequate buffers from residential areas and local employees are hired to the maximum extent practical.

4.3.3 COMMUNITY FACILITIES AND SERVICES

Impacts to community facilities and services can be minimized if proper mine plan, process and support facility siting, and employment programs based on maximizing local hiring are developed. Mine plans should integrate the existing highway and rail infrastructure and consider

improvements if necessary. The road connecting Rakvere with Kunda is not heavily traveled and currently carries a high percentage of truck traffic due to the agricultural activity in the area and the existing limestone mine. Additional traffic on M-11 could create local congestion during times of peak use and could cause safety concerns at the intersection of the road from Rakvere to Kunda with M-11. Unit trains may also disrupt local and regional traffic patterns.

The extent of potable water and wastewater facilities is unknown at this time; however, their availability and adequacy for incoming employees and their families must be assured. The provision of potable water and sanitary sewer facilities at the mine, beneficiation plant, and chemical plant is assumed. Adequate police, fire, health, and educational facilities must also be available or expanded to meet the increased demand generated by incoming employees.

Development of the proposed mine and processing and support facilities also must not impact the value or use of Lahemma National Park, located 25 km west of the Toolse phosphorite deposit.

4.3.4 ECONOMY

The construction and operation of a phosphate mine, beneficiation plant, and possibly a chemical plant will have a positive impact on the local, regional, and national economies. Wages paid to mine and facility employees are generally high compared to many other trades. Expenditures for materials, supplies, and services are also considerable; economic benefits would be distributed to numerous types of economic sectors.

4.3.5 CULTURAL RESOURCES

Impacts to cultural resources will be negligible within the perimeter of the limestone mine due to previous clearing of the surface and the excavation of soils, overburden, and limestone. These activities would have disturbed any pre-existing archaeologic or historic sites. Agricultural activities in other portions of the area within the Toolse phosphate deposit have probably disturbed at least the surficial component of any site. Archaeologic resources may exist within the undisturbed portions of the area planned for the mine, beneficiation plant, and chemical plant. In addition, farmsteads in the area appear to be old and may have historic and architectural significance.

4.3.6 AESTHETICS

Visual impacts from mining the Toolse phosphorite deposit will be limited to areas of public access (rights-of-way) and to farms and nearby communities. Mining activity will be visible from the road between Rakvere and Kunda since this facility bisects the phosphorite deposit. Mining activity may also be visible from M-11 if the southeastern-most portion of the mine is excavated (see Figure 3-4). Depending upon their location, the beneficiation plant and chemical plant may also be visible from these roads and certain farms and residential areas. These impacts are not expected to be significant because the area is, due to a relatively flat topography, not noted for its vistas. In addition, there is an existing mine and industrial facility near Kunda, the nearest town to the phosphorite deposit. The proposed facilities could be viewed as an expansion of existing mining and industrial land use, an occurrence that would be more desirable than developing these activities in an area without such uses.

5.0 ENVIRONMENTAL REGULATORY REQUIREMENTS

Current environmental legislation in Estonia is a result of laws passed prior to and during Soviet rule and new laws that have been passed since the recent establishment of the Republic of Estonia. The framework for recent and current environmental legislation is provided by the Law on the Protection of Nature in Estonia, approved on February 23, 1990.

Many of the environmental standards in effect are based on the Maximum Permissable Concentrations system developed in the former Soviet Union. Standards have been developed for air quality, potable water quality, water in natural water bodies, and soil. A number of these standards are being revised with new legislation.

Incentives for businesses to operate in an environmentally responsible manner or otherwise achieve compliance with environmental standards are based on resource charges and pollution taxes. Resource charges have been instituted to provide economic incentive for rational and efficient use of mineral resources, including oil-shale, natural building materials, peat, and water. Charges are based on the volume of resources used. Pollution taxes have been established for air, water, and waste. Air pollution taxes are charged for the volume of specific pollutants emitted. Taxes may also accrue as a result of the character of the polluted area. Water pollution taxes are also charged for the volume of pollutants discharged. Taxes for waste are calculated progressively in relation to the level of toxicity of the waste. The development of environmental policies, strategies, and regulations is the responsibility of the Ministry of Environment. The Ministry also grants permits for geologic exploration and requires environmental impact statements (and reclamation) for mining. The local administration is responsible for granting water use, water discharge, and air permits. Land use approvals are the responsibility of the Ministry.

6.0 MITIGATION AND MONITORING

Many of the environmental impacts associated with surface mining, beneficiation, and chemical processing can be mitigated sufficiently to minimize long-term adverse impacts. Environmental monitoring insures the proper implementation of the mine plan and subsequent mitigation activities. Monitoring also provides data on existing environmental conditions and impacts that can be compared to projected impacts to verify the accuracy of the projections and the adequacy of mitigation programs. A mitigation and monitoring plan should be required and developed to maximize the integration of the mine and processing facilities within the environmental constraints that exist in the vicinity of the Toolse phosphorite deposit and minimize the effects of proposed development on the physical, biological, and socioeconomic environment.

Mitigation requirements can only be effectively determined after a detailed impact assessment has been conducted. This assessment will require the development of a mine plan and careful siting of processing and support facilities. Potential mitigation activities that may be required to successfully mine and process phosphorite in an environmentally acceptable manner include the following:

1. Conduct resource surveys within the project area and its vicinity to assure accurate impact assessment, develop a mine plan that is sensitive to existing environmental conditions and issues, and properly site processing and support facilities. This mitigation task will minimize overall impacts.
2. Spray areas cleared of vegetation, with emphasis on roads and other areas subject to vehicle or equipment activity. This mitigation task will minimize airborne dust and resultant impacts to air quality.
3. Provide emission controls for vehicles and equipment, including facilities associated with beneficiation and chemical processing. This mitigation task will minimize impacts to air quality and provide assurances to meet air quality standards.
4. Conserve water consumption by preparing a water minimization plan that includes water reuse and recycling. This mitigation task will minimize impacts (cone of depression) to the local aquifer(s), which are assumed to be the source of water make-up.

5. Minimize the excavation of aquifers. This mitigation task will minimize the water quality and quantity impacts to local aquifers and the potential reduction to flow in the Kunda, Toolse, and Selja Rivers.
6. Control stormwater runoff, use sediment control structures/practices, and revegetate promptly. This mitigation task will minimize water quality impacts to the Kunda, Toolse, and Selja Rivers.
7. Treat stormwater runoff and industrial and domestic (sanitary) wastewater. This mitigation task will minimize water quality impacts and provide assurances to meet water quality standards.
8. Isolate dictyonema shale and other components of the overburden or processing wastes. This mitigation task will minimize impacts to air, surface, and groundwater quality resulting from the anticipated self-ignition of the shale and leaching of metals and other contaminants into the surface and groundwater.
9. Restrict mining and siting of processing and support facilities in floodplains and wetlands. This mitigation task will minimize impacts to surface water quality and wildlife habitat.
10. Reclaim portions of the mine to forage and habitat favorable to local wildlife. This mitigation task will minimize impacts to wildlife and wildlife habitat.
11. Prepare a spills plan to facilitate prompt clean up of any accidental spill of raw materials, fuels, or wastes. This mitigation task will minimize impacts to air quality, soils, surface water and groundwater quality, vegetation, and wildlife.
12. Manage the off-site traffic requirements associated with employee, equipment, and raw material or product transportation. This mitigation task will minimize impacts to the current use of the road from Rakvere to Kunda, M-11, and other nearby roads.
13. Relocate any residents and businesses that are located in areas to be mined and provide for all expropriation and resettlement costs and improvements needed in the host community to accommodate the relocated population. This mitigation task will minimize economic impacts to the population in the affected areas.
14. Colocate facilities and support facilities. This mitigation task will minimize impacts to existing land use patterns.
15. Provide off-site community facilities and services if necessary. This mitigation task will minimize impacts to existing community facilities and services.

16. Retain local residents for construction and operation employment requirements to the maximum extent practical. This mitigation task will minimize impacts to community facilities and services and maximize the economic gain to the population that will be affected by the proposed project.
17. Require environmental education/training of key construction and operation managers and employees. This mitigation task will create a necessary understanding of the environmental impacts of mining and processing activities and will result in assurances of a more successful mitigation program.
18. Use earth mounds (berms) and vegetative screening. This mitigation task will minimize visual impacts.
19. Prepare a public involvement plan to disseminate project information and obtain input from the local population.

Monitoring of environmental impacts and mitigation activities will also be required to ensure the integration of the proposed project with the environment to the maximum extent practical. Similar to mitigation planning, the development of a monitoring program can only occur after the mine plan and process and support facilities are accurately determined. Monitoring requirements are likely to be required at Toolse for the following:

1. Ambient air quality and emissions;
2. Workspace air quality and noise levels;
3. Ambient water quality, stormwater runoff, and point-source discharges;
4. Surface water flow;
5. Groundwater drawdown at the mine perimeter;
6. Management and disposal of wastes;
7. Stability of slopes;
8. Restoration of land surface;
9. Revegetation and reclamation;
10. Visual checks for leaks and spills;
11. Expropriation, relocation, and resettlement; and
12. Adequacy of community facilities and services.

The development of a comprehensive mitigation and monitoring program is thought to be technically feasible. Surface and groundwater mitigation and monitoring activity has occurred at

Maardu, where phosphorite mining and beneficiation has historically occurred. Land reclamation activities have also been implemented. As a result, environmental impacts and issues associated with mining and processing of phosphorite are well known. Through the cooperative efforts with, in particular, Scandinavian countries, mitigation of several impacts at Maardu is underway, including the resolution of air and water quality impacts associated with dictyonema shale, a component of the overburden that also occurs at Toolse and will likely prove to be one of the most difficult impacts to manage.

The social acceptance of the proposed project will hinge, in part, on the accurate and thorough evaluation of physical, biological, and socioeconomic impacts, the use of the local population for construction and operation employment requirements to the maximum extent practical, and a comprehensive public participation and education program. The demonstrated resolution of environmental impacts associated with the mine and process facilities at Maardu will also be a factor that will determine the social acceptance of the project.

The economic feasibility of implementation of a comprehensive mitigation and monitoring program is unknown at this time. There are costs associated with the preparation and implementation of these programs. The consideration of environmental criteria in mine planning and process and support facility siting will likely result in a reduction in minable reserves and additional costs for pollution control facilities. However, it is recognized that some of these costs were incurred at Maardu. Detailed technical and economic feasibility studies will need to be undertaken before the economic feasibility of environmental mitigation and monitoring can be determined.

7.0 RECOMMENDATIONS

7.1 ASSESSMENT OF ENVIRONMENTAL IMPACTS

A comprehensive environmental assessment will be required to verify that the mining of the Toolse phosphorite deposit, beneficiation, and, possibly, chemical processing can occur in an environmentally acceptable manner. The assessment of impacts and development of mitigation and monitoring programs should be prepared by mining and processing experts, as well as those individuals familiar with local and regional physical, biological, and socioeconomic resources. The assessment can only be conducted after a mine plan and beneficiation and chemical processing requirements are known.

Several baseline studies will be required in order to evaluate environmental impacts. These studies will also be critical in developing an environmentally acceptable mine plan and assist in the proper siting of processing and support facilities. The recommended baseline studies include the following:

1. Air resource study to establish local meteorology (wind speed, direction, and rainfall) and ambient air quality.
2. Surface resource study to establish watershed boundaries, stream flows, surface water use, surface water quality, and floodplain limits.
3. Groundwater resource study to verify existing data on location of the aquifers and aquicludes, water level fluctuations, transmissivity, and groundwater quality.
4. Vegetation and wildlife survey to establish the location, extent, and composition of vegetation communities, including wetlands, wildlife habitats, existing wildlife, and the presence of endangered or threatened species.
5. Demographic study to establish the size, ethnic composition, labor skills, and economic well-being of the local population.
6. Land use study to establish the number of homes (and other improvements) and families in the vicinity of the Toolse phosphorite deposit that may require relocation and resettlement.
7. Community facility and service inventory to establish the type and quality of infrastructure and services the local population and nearby cities currently enjoy.
8. Cultural resources study to determine the presence of any archaeological or historic site.

In addition to these baseline studies, a public involvement plan should be prepared and implemented. This plan would be developed to; 1) inform the local residents and Viru County officials of the proposed technical, economic, and environmental studies that will be undertaken; 2) obtain information from the local population that can be integrated into the baseline documentation and impact analysis; 3) obtain input on mine plans and process and support facility plans for refinement of those plans, if necessary; and 4) educate the public on the development of plans and studies, the extent of impacts, the mitigation and monitoring programs required, and the extent of opportunities available to the local labor force.

7.2 DEVELOPMENT OF PROJECT ALTERNATIVES

The development of mining plans and siting of processing and support facilities, including the pollution abatement requirements of those facilities, need to occur with a complete understanding of the environmental constraints and opportunities. The integration of environmental factors into mine planning and facility siting will result in reduced environmental impacts and, consequently, reduced mitigation and monitoring requirements. In subsequent technical and economic feasibility studies and the development of project alternatives, the following environmental factors should be considered:

1. Initiate phosphorite mining in the present limestone mine, if feasible;
2. Use the existing limestone mine to place overburden and isolate wastes, if feasible;
3. Avoid mining significant wetlands, particularly the forested riverine wetlands of the Kunda and Toolse Rivers;
4. Avoid mining floodplains and significant cultural resource sites or locations of endangered and threatened species if present and unmitigatable;
5. Avoid siting processing and support facilities within wetlands, floodplains, and other sensitive resource areas;
6. Avoid siting processing and support facilities in the vicinity of residential areas;
7. Design and equip processing and support facilities so that water resources are conserved and air and water quality standards can be met; and
8. Plan to hire local labor to the maximum extent practical, and establish training programs to prepare local candidates for future employment opportunities.