

Environmental Impact Assessment and Evaluation of Low-Volume Roads in Finland

ANDERS H. H. JANSSON

Environmental impact assessment (EIA) practice in Finnish road design is as yet an informal procedure; a law on EIA is expected in 1993. Methodology in development since 1990 has been tested on several projects, most of them large scale. Low-volume rural roads are ideal for introducing many of the objectives and procedures of EIA, but formalized schemes in such small projects should be avoided. The Finnish experience shows that the attitude of the designer, willingness to accept as valid points of view not one's own, thorough familiarity with local conditions and goals, and extensive cooperation with local people and authorities are essential to the success of the EIA as well as to the design of these roads. A process view on EIA emphasizes the tasks related to project initialization and start-up. If a process of active co-operation characterizes the whole project, formal reporting and decision stages will have a minor importance.

A Finnish law on environmental impact assessment (EIA) is to be adopted in 1993 (1), as the formation of the European Economic Area brings the European Community directive on EIA into force in Finland. The proposed law is modeled on the 1991 United Nations Economic Commission for Europe convention on the assessment of transboundary effects (2). The Finnish National Road Administration has been developing an EIA methodology since 1990 on the basis of international experience and the proposed law. The first Road Administration guideline on EIA was published in 1992 (3).

Regulations on assessment concern only large-scale projects. However, in low-volume rural road projects an integrated and participatory process where environmental concerns are given an equal footing with technical and other goals can be easily realized.

Development efforts aim to set standards for both the legally required EIA and the "local EIA" so that they will strengthen each other by interaction, large-scale EIA introducing the formal system and local EIA familiarizing road designers and others with the attitudes and methods of environmentally integrated cooperation.

THE RURAL ROAD, A BACKBONE OF DEVELOPMENT

After World War II, Finland had to replace the resources consumed by the war, resettle the inhabitants of areas ceded to the Soviet Union, and develop an agricultural society into a modern, urban, and industrial one. The Finnish road net-

work, inadequate in the early 1930s, was in a catastrophic condition by the late 1940s. Large areas were without functional road connections. An enormous road-building effort centered on renewing the main roads network was necessary. But the rapid extension of the smaller rural roads was a simultaneous process. Without these roads, resettlement or development in rural areas would not have been possible.

Today, out of 77 000 km of public roads, connecting and collector roads form 57 000 km and carry 30 percent of total public road vehicle mileage. The average daily traffic on connecting roads is 280 vehicles and on collector roads 650. Fifty percent of the public roads have gravel surfacing and 30 percent light bituminous surfacing (4). These roads are still the backbone of regional structure. Though 80 percent of our population live in urban areas, an efficient rural road network is the basis of continued rural habitation.

FINNISH ROAD DESIGN PROCEDURE

Design of public roads is regulated by the Road Act. At present, the Road Act specifies only the legal approval of the final design. In addition, the act provides for preliminary design stages, but without specifying the procedures to be followed.

In practice, the road design procedure has developed into a system of plans, programs, and preliminary and final design stages (5). Project design starts with Road Administration feasibility or preliminary location studies. For projects deemed feasible and necessary, a project decision is made. Depending on project size, the decision is made by the Regional or Central Road Administration or the Transport Ministry. The decision does not specify alternatives to be studied but sets general goals for the project.

Road projects are designed by the Regional Road Administrations, assisted by consultants. The preliminary design aims at fixing the main features of the project, including its general alignment. The goals are interpreted into specific objectives. Alternatives are studied and assessed. From an environmental point of view, this is the most important design stage. It ends with the project decision, giving the Regional Road Administration the right to commence final design. An approved project decision is a condition for including the project in the road construction program.

The final design stage was originally the only stage of road design. As new stages have been added, it has taken on a technical character, implementing the main features decided

upon at the preliminary design stage. The final design is the basis for legal approval of the project. The approval decision is made by the Transport Ministry. Landowners and authorities can appeal against this decision.

A proposal for a new Road Act is being prepared. The preliminary design stages are specified in the proposal. The project decision and its legal consequences would be included in the act. This would allow appeal against the project decision, thus extending public influence on road design (6).

EIA LEGISLATION AND ROAD DESIGN

The main steps of the assessment procedure in the Law on Environmental Impact Assessment, as proposed by an Environment Ministry task force (1), are as follows (see Table 1 and Figure 1):

- Deciding whether a project is subject to assessment,
- Making an assessment schedule and consulting on the schedule,
- Performing the assessment,
- Publishing the assessment document and consultation, and
- Deciding on the project, taking the assessment into account.

For road projects, the Regional Board of Administration would be the authority directing the process. The board would have the right to appeal against project approval if it finds that the EIA has not been properly carried out.

Appended to the law is a decree on implementation. The projects subject to the law are listed in the decree. For roads, they are motorways and semimotorways. The law contains criteria for determining the environmental significance of projects not specifically listed:

- (1) The location of the project and its possible effects on important natural and cultural values and objects of special sensitivity as well as human health, living conditions and welfare,
- (2) the extent of the area of influence of the project, and (3) the possible combined effects of the project and other projects and activities. (1, translation by the author)

These criteria extend the law to main and major trunk road projects as well as most projects in dense urban areas.

The Road Administration guideline requires an EIA for all projects that have at least some significant impacts. The guideline groups projects as follows:

- Projects with significant environmental impacts over large areas (motorways, semimotorways, and projects deemed to

TABLE 1 Proposed EIA Legislation in Finland (1)

ONE EIA LAW, PROJECT DECISIONS BY SEPARATE LAWS	The assessment procedure is regulated by one law. Project decisions are made according to the separate laws governing project approval and implementation.
ASSESSMENT OF PROJECTS, PLANS AND PROGRAMS	Projects that can have significant detrimental environmental impacts are subject to this law. Authorities preparing plans and programs are also obliged to assess their environmental impacts.
TRANSBOUNDARY IMPACTS ASSESSMENT	The law concerns transboundary impact assessment in accordance with the United Nations Economic Commission for Europe convention of 1991 (2).
POSITIVE LIST AND CRITERIA OF SIGNIFICANCE	The decree appended to the law lists projects subject to the law, mainly in accordance with the ECE convention mentioned above. For roads, projects listed are motorways and semi-motorways (corresponding to "express ways" in the convention). The law states criteria for considering projects not specifically listed.
COORDINATION WITH OTHER PROCEDURES	In implementing the law, similar procedures already performed according to other laws will be taken into account to avoid multiple procedures.
EARLY ASSESSMENT	The environmental impacts of a project are to be assessed at the earliest stage possible.
COMPETENT AUTHORITY DIRECTION	The proponent of a project is responsible for the assessment, but the assessment procedure is directed by a competent authority. For road projects, the competent authority is the Regional Board of Administration.
EIA DOCUMENT AND PUBLIC CONSULTATION	An environmental impact assessment document (impact statement) is made by the proponent and published by the competent authority. The people concerned have the right to present their views on the project, its impacts and the document. Consultation procedures according to other laws concerning the project are taken into account.
TAKING EIA INTO ACCOUNT	No decisions to implement a project subject to EIA law may be taken before finishing the assessment. The decision is to state how the document has been taken into account.

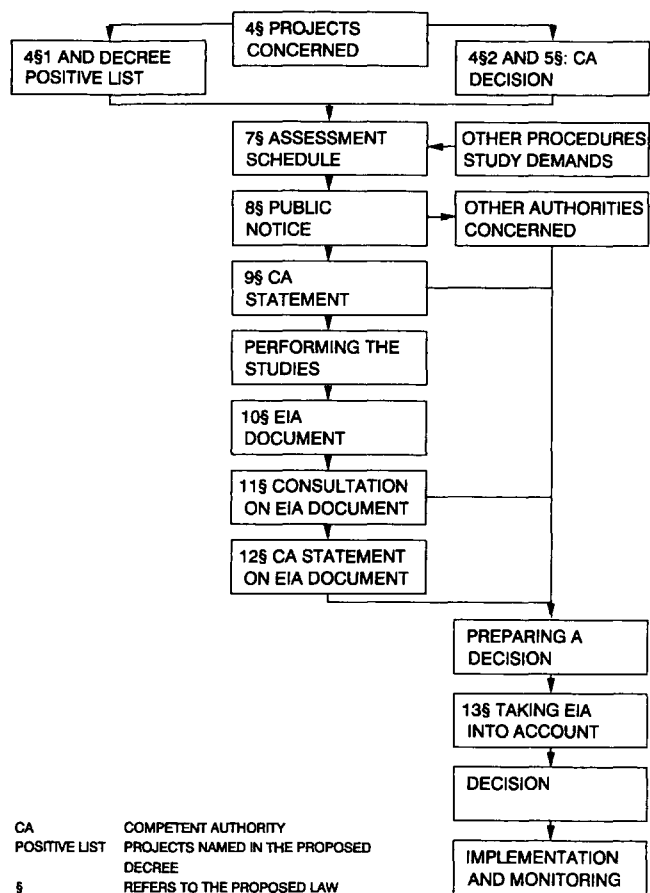


FIGURE 1 EIA procedure as defined by the proposed law and decree (I).

have impacts in accordance with the criteria in the law): These projects are subject to legally defined assessment.

- Projects with environmental impacts on a regional scale: These projects are assessed in accordance with the Road Administration guideline by decision of the Regional Road Administration.

- Projects with local environmental impacts: These projects are assessed by Regional Road Administration decision in a way that realizes the principles of assessment. The administration decides on how the assessment is performed.

- Projects with few or insignificant environmental impacts: No assessment procedure is foreseen. Environmental impacts that may arise are to be documented and, if need be, mitigated (3, translation by the author).

For projects subject to the law, the assessment procedure would be included in the preliminary design process, which the present Road Act does not recognize.

Thus legal EIA requirements are directed toward approval of the final design. From an environmental viewpoint, this is too late, since all the crucial decisions were made earlier. Until the Road Act is revised, the assessment document will be appended to both the preliminary and the final design.

For projects with regional impacts, typically minor trunk road and major collector road projects, the Road Administration guideline recommends the same general procedure as for large-scale projects.

Collector and connecting roads usually have local impacts. They are subject to "local EIA" development. A preliminary design stage is not required, and the procedures in use for regional and large-scale projects are not appropriate.

ENVIRONMENTAL CONCERNS OF LOW-VOLUME RURAL ROAD DESIGN

Low-volume rural road design is traditionally based on minimizing construction outlays and maximizing local utility, for instance by providing direct access to as many habitations as possible. Essentially, these considerations tend to support environmentally responsible design. A close fit to geological and hydrological features, an economy of terrain limiting cuts and embankments, consideration of landownership and boundaries, and service of a specific local traffic need will all contribute to fitting the design to landscape and land use.

On the other hand, minimizing design expenditure may result in insufficient inventories or alternative studies. Maximizing utility may impair traffic safety as well as objects or areas of environmental importance. A short alignment may destroy village structure or the landscape. Thus, a main environmental concern of low-volume rural road design is to ensure a general alignment supportive of landscape and land use. The alignment should also, if possible, avoid intruding into nature reserves or other areas of importance for the preservation of nature, since land use development will follow roads.

On a technical level, environmental concerns are directed toward keeping the footprint of the road as narrow as possible, protecting groundwater catchment areas and other natural resources, and effectively utilizing existing road alignments. In a landscape with numerous lakes and rivers, crossings form a special problem. Bridges and embankments cannot be avoided, but their technical requirements presuppose a scale out of keeping with the road itself.

PUBLIC ROAD 5053

In 1991, extension of EIA to projects with local impacts was tested on Public Road 5053, in eastern Finland. This road, with an average daily traffic of 240 to 350 vehicles, serves the Eno municipality and connects a paper plant in Uimaharju village and the Koli nature park area with the main road network. There was a need to improve the technical standard and the alignment of the road. The total length of the project is about 20 km. The major impacts would be caused by changes to 3 km within the village of Ahveninen and 5 km within the Paukkajänvaara-Kaltimonlahti forest area, to the west of the village.

The road design procedure was in its final stages when the North Karelia Regional Road Administration (NKRA), in cooperation with the Regional Board of Waters and the Environment (NKBWE), decided to perform an environmental assessment. During the summer of 1991, NKBWE made a study of the features of the Paukkajänvaara-Kaltimonlahti area. NKRA concentrated on impacts on Ahveninen village.

A report on the assessment was prepared by NKRA in cooperation with the Central Road Administration (7). The

report noted that the assessment process was started too late to have significant effects on road design. Although the village inhabitants believed that such late consultation would not significantly influence decision making, they appreciated that NKRA took the initiative to explain and discuss the project and its impacts. Two village meetings were held and a series of interviews performed. Villagers proposed several alternatives to the projected alignment. New alternatives were included in the assessment, as were the "no action" alternative and a "do minimum" alternative that would not change road alignment.

On the basis of the discussions held, the assessment took the form of a description of the impacts of the alternatives on the village. The factors are given in Table 2. For the forest area, similar alternatives were formulated and assessed by NKBWE. The 4-month assessment timetable was too short for adequate coordination between NKRA and NKBWE.

As a result of the assessment, NKRA made minor changes in its original proposal. However, the questions raised by this process have changed the system of interagency cooperation in the region as well as NKRA programming practices. A follow-up report, extending the conclusions of this and other similar cases, was prepared by the Central Road Administration (8).

EIA PARADOX

The low-volume rural road has a paradoxical role when seen in the EIA context. It is not in the public interest to add a formal EIA methodology to the design of low-volume road projects. Legal and formal requirements should be restricted to projects that can have severe impacts over large areas. But

the relatively small scale and continuous flow of projects make low-volume roads ideal for realizing the substance of EIA. Conflicts of interest are fairly easy to identify, alternatives are limited, and local solutions possible. A single road designer can, with the assistance of "visiting experts," manage an entire project through continuous communication and cooperation with the local people. No multilevel planning organization is needed.

But this somewhat rosy picture does not really bridge the gap between the road engineer and the environment the project will change. Conflicts arise and remain unresolved. Popular sentiment may see road building as a steamroller with little concern for local values:

The original Ahveninen villagers feel cheated. They were told that the Road Administration had introduced a new procedure, giving local people a say in road design. They did have their say: there was one who came to each household asking questions and meetings were held, but . . . [7, quoting Karjalainen newspaper (translation by the author)]

EIA methodology development has been tested on several other projects. Conclusions are to a great extent centered on matters of attitude independent of scale. Indeed, specific methods of data gathering, prediction, or assessment need development mostly in large-scale projects; in low-volume road projects their importance is secondary. A low-volume road EIA process stands on the following:

- The professional competence of the road designer,
- The interests and environmental objectives arising out of the locality itself, and
- The values of the local inhabitants and their willingness to actively cooperate throughout the design process.

TABLE 2 Public Road 5053, Assessed Factors (7)

1. FACTORS ASSESSED FOR AHVENINEN VILLAGE	
TRAFFIC SAFETY	To ensure the best possible traffic safety for goods transport, passenger car traffic, pedestrians and cyclists.
TRAFFIC SERVICE LEVEL	To ensure an optimal traffic service level for goods transport and cars.
VILLAGE LANDSCAPE	To preserve the village landscape, especially the open field areas and the characteristic village road.
VILLAGE STRUCTURE	1. To preserve village structure, alternatively 2. To change village structure in order to enhance the possibilities for new service outlets.
NATURAL VALUES	To minimize ecological damage.
AGRICULTURE	To minimize field area loss and severance of farm areas.
CONSTRUCTION AND MAINTENANCE	To ensure an optimal technical standard and costs of construction and maintenance.
2. FACTORS ASSESSED FOR THE PAUKKAJANVAARA-KALTIMONLAHTI FOREST AREA	
ECOLOGY	To minimize ecological damage.
NATURAL LANDSCAPE	To minimize disruption of landscape elements and to minimize visual intrusion.
SENSITIVE AREAS AND OBJECTS	To preserve areas and objects of special ecological sensitivity or importance.

PROFESSIONAL COMPETENCE AND ENVIRONMENTAL COMPETENCE

The road designer's competence is mainly technical. There is a readiness to avoid damaging objects or areas seen as important, but the need to improve the designer's competence is illustrated by the question, "What is important?" Here, the decision given by the designer will often differ from one given by environmental authorities and others.

The problem is not that the designer does not know how to identify a rare bird. One can always ask. But one must be willing to ask and to accept an answer by somebody competent in another field than one's own as relevant. To achieve this, the designer needs a broad view: to see areas and processes as a whole and to realize how the identification of a valuable feature can define an important area. Even a vague notion, received sufficiently early, is an indication that can influence a whole project.

Vision is difficult to transmit by teaching or marketing methods. At present we encourage the Regional Road Administrations to organize seminars with local universities on environmental themes. Such seminars, with the local footing given by the university and representatives of local authorities, may start a thought process with practical consequences. It is a question of prying attitudes loose, freeing the ordinary thought of the designer from the strictures set upon it by earlier training and organizational uniformity. If that succeeds, the engineer's bent will drive most designers to find new visions and tools by themselves.

Thus, the first step would be to use the road designer's competence and attempt to change the attitudes, then let the designer's own ambition widen that competence.

UNDERSTANDING THE LOCALITY

Everybody understands one's own neighborhood or town and how different influences and processes have shaped its development. But in a professional context, the understanding is clouded by real or assumed standards or practices. On low-volume road projects, clouding is most easily seen in, for instance, straightening a curve to some standard radius even though no accidents or other impairments have occurred, or widening a carriageway from 7 to 8 m. A standard value is followed, whether or not it is needed locally.

Some standards are obligatory; the road network may not vary indefinitely. But the application of these standards must never be automatic. Every decision must be appropriate for the place and needs concerned.

Even on small roads, some large-scale interests may be present. The transport needs of heavy industry or occasional tourist rush traffic are among these. In Finland, the most common are national environmental protection interests. These may or may not coincide with local interests. But their presence carries the problem to another level: national interest implies a full-scale EIA procedure and its methods of solving conflicts.

On low-volume roads, local interests and environmental goals are generally predominant. The designer should be made aware of their role and should withhold judgment until attaining an understanding of what this very place is about.

Technical and construction decisions should never be made before determining that they are necessary.

Thus, the second step is to demand that the designer be thoroughly familiar with the locality, its inhabitants, and its terrain before drafting any alternatives. No technically motivated solution should be accepted unless a convincing need is shown.

COOPERATION

On low-volume road projects, the conditions for cooperation between designers and the public are ideal. The concerned population seldom exceeds 1,000; its active representatives are perhaps a few dozen people. One can meet face to face, discuss on the spot, and show the proposed road by putting markers into the ground or walking along a line.

Traditionally, the engineer, as a representative of state power and officialdom, has been seen as above ordinary people. The chairman of the local authority was invited to meetings, others not, nor did they presume to intrude. This tradition is by no means dead. Communication based on such a tradition cannot result in active or continuous cooperation.

A starting point is asking people what is important. Then, one can present possible ways of reaching the important goals by this one method, road construction, and let people evaluate whether it is worth it. The back-and-forth will continue through the stages of formulation and evaluation of alternatives, proposals for action and mitigation, and so on. This is also the natural way of presenting a report of proceedings to people. What is then put into the formal report is of minor importance.

The third step is making a conscious effort to contact the concerned people and keeping them involved in the real design and decision making. Then, one can expect continuous cooperation. Presentations "for discussion" of decisions already made are seen through and mean the end of cooperation.

PROCESS VIEW OF EIA

EIA development for low-volume rural roads encourages a process view of assessment. The basis of EIA is the need for an environmentally responsible design process. The procedural constraints set by law are simply a framework to give the process an administratively efficient shape. On low-volume rural road projects, formal stages of design are few. The assessment process shows itself as a natural way of organizing the designer's work.

A description of the process from the designer's viewpoint could take the following form (Figure 2):

Project Initiation

The technical motivation for a road project may arise out of accident black spots, damaged road structure, difficulties for pedestrian or bicycle traffic, or a notable rise in traffic volume. The motivation of regional development exists if a road is substandard as a connection in the road network or if it generates unnecessary traffic because it does not serve land use effectively. An environmental motivation can be that the road

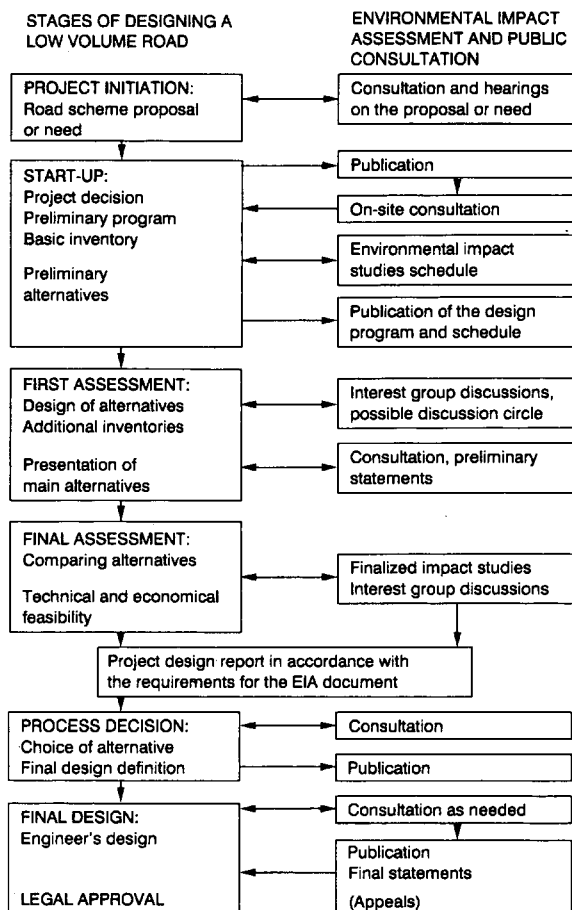


FIGURE 2 Process of design and assessment of a low-volume rural road project.

disturbs housing, impairs landscape, or may constitute a threat to valuable objects or areas.

If the Regional Road Administration has seen that a need to improve a road or build a new one may exist, or a public initiative to that effect has been made, the matter should be discussed in a wide context. The administration can call people to a hearing or invite them to give their views in other ways. At this stage, no project need be specified. Discussions are based on the present road network and the problems it may contain; the goals for development of the area, and of its environmental qualities, that people and various authorities have; and the Road Administration's scope of action: what can it do and what are, in general, the effects of a road project.

The last point implies another sector of environmental assessment, which we call "product and service assessment" (9). It is based on the idea of technology assessment. In this respect it means that, for instance, a class of roads, or construction activities, should be studied in general as a basis for predicting what to demand or expect from a specific project. This type of assessment would assist in simplifying studies of small-scale projects.

Start-Up

On the basis of the discussions held, the administration decides whether there are grounds for starting a project and what goals

it should serve. A designer is named and a preliminary timetable and budget are set. The decision is published.

The designer's first task is to shape the framework of the project. Views and preconceptions are tested by visiting appropriate authorities and by a "walking conference," informing people beforehand where and when the designer will be studying the terrain. At this stage, all available material, from maps and aerial pictures to local authority plans and inventories, is gathered. It is an advantage if this collection and at least part of the designer's work can be located in the area concerned.

These studies should lead to a preliminary set of alternatives, including "no action" and "do minimum." The number of alternatives can be large, each alternative serving some specific goal. Avoidance of ready-made compromise alternatives helps determine whether there are real conflicts in goals or values. A sufficiently large number of alternatives helps to clarify which possible impacts or targets are important for this project.

Environmental and other experts are called upon to determine what kind of further research and inventory is needed and how long they will take. Even in these projects, some biological field studies could take a couple of years.

The full schedule of research, assessment, and design of the project should be published, not just a separate EIA schedule. Preliminary goals and alternatives are reported, giving for each the constraints and relationships known and what studies will be made.

First Assessment

The aim of the first assessment stage, which runs parallel to terrain inventories and other studies, is to narrow the alternatives, especially to discard those having grave deficiencies. A balancing of technical and environmental criteria will take place. This presupposes a new round of discussions. At this stage, it is to be expected that local opinion has to some extent solidified and group interests—and, conversely, defined interest groups—show up. An interest group can be an authority, the landowners of a village, a local history society, and so forth.

If possible, a committee of participating experts and interest group representatives is formed to carry on discussions. This is a mutual learning stage, each teaching the others to analyze the problem from its own viewpoint. The road designer need not be in charge. That position could be held by a local representative. Inventory data and study results are brought into the process continuously.

Consensus is sought, but it may not emerge. Two or three main alternatives are formed to express any conflicts as clearly as possible. The alternatives are presented to the public and views are invited. The views of authorities can be given as preliminary statements. In presentation, the emphasis is on general readability and a review of uncertainties or difficulties rather than on technically finished design material.

Final Assessment

The object of the final assessment is a choice of one alternative or a decision to drop the project. The previous discussions

form the basis for deciding what features of each alternative should be studied further.

Experts have an important role in this stage. Formal prediction methods may be used. The interest group committee acts as a sounding board, forcing the experts to clarify their professional knowledge in nontechnical language. The committee aids the road designer in decisions on priorities.

Impacts on future land use and social concerns will need special study. The secondary and tertiary land use adjoining a small road has much greater impacts than the road itself. Notable social impacts can be brought about because the road, though small, may be the strongest development factor in an outlying village. Usually, development plans concerning the immediate vicinity of the projected road are sketchy or nonexistent.

In this respect, the interest group committee is a primary source for the researcher. The interests represented are mainly the ones that shape development. The local authority may at this stage take on the task of drawing up zoning or other plans, but discussions within the committee will also give a fairly reliable picture of what development trends may be expected and of how people value the effects of the project on their own future and welfare.

In this stage, technical precision will also be needed. Recommendations on alternatives must be technically feasible and costs must be calculated. In tight spots, exact drawings may be needed, though they should not be used as the main design tool. A design report is drawn up following the general contents of an EIA report.

Process Decision

The report is presented to the public, possibly in a second walking conference. The responsibility of deciding which alternative to choose rests with the Regional Road Administration, but the process should by now have given a clear indication of how to choose. The decision states what alternative is chosen, on what grounds, and how this alternative has been formed by the design process. Questions still to be solved through detail studies are identified, as well as any detrimental effects the alternative may have and how they can be mitigated.

Final Design and Formal Decision

The design is finalized by the road designer, checking open details with the concerned people. At this stage, the drafting

and map style of engineers' design is used. The formal decision on the road project is the approval of the final design, as defined by the Road Act. For this, official statements are given by the authorities. The design is shown publicly. Landowners and others can present complaints against it, if necessary.

CONCLUSION

In a low-volume rural road project, formal procedure should be avoided. The experience and attitude of the road designer are paramount in devising an environmentally responsible design process. A spirit of open inquiry should prevail. Specific technical solutions and expressions should, in the main, be limited to the final stage of design.

REFERENCES

1. Ympäristöministeriö, YVA '92-työryhmä. Ympäristövaikutusten arviointi (Environment Ministry task force proposal for the EIA law and decree). Ympäristöministeriö, ympäristönsuojeluosasto. Työryhmän mietintö 65 1992. Helsinki, Finland, 1992.
2. *Convention on Environmental Impact Assessment in a Transboundary Context*. United Nations Economic Commission for Europe, Espoo, Finland, 1991.
3. Tiehallitus, kehittämiskeskus. Ympäristövaikutusten arviointimenettely tiehankkeiden suunnittelussa (Road Administration guideline on environmental impact assessment in the design of road projects). Tiehallituksen ohjeita 1992. Helsinki, Finland, 1992.
4. *Public Roads in Finland 1.1.1991. FinnRA Statistical Reports 2/1991*. Finnish National Road Administration, Helsinki, Finland, 1991.
5. Liikenneministeriö. Tiepoliittisen päätöksenteon uudistaminen, hankekohtaisen päätöksenteon vaiheistaminen (Transport Ministry report on reform of the road project decision making process). Liikenneministeriön julkaisuja 5/90. Helsinki, Finland, 1990.
6. Tiehallitus, oikeuspalvelut. Luonnos hallituksen esitykseksi eduskunnalle maantieliksi (Road Administration draft of the government proposal to parliament for a Road Act). Helsinki, Finland, 1992.
7. Karvinen, P. Ympäristövaikutusten arviointiselostus, maantie 5053 (Report on the environmental impact assessment, public road nr 5053). Tielaitoksen selvityksiä 55/1991. Helsinki, Finland, 1991.
8. Karvinen, P. Ympäristövaikutusten arviointimenettely paikallisissa tiehankkeissa (Environmental impact assessment of local road projects). Tielaitoksen selvityksiä 10/1993. Helsinki, Finland, 1993.
9. Tiehallitus. Tielaitos ja ympäristö, tielaitoksen ympäristöpolitiikka 1992 (Environmental policy of the National Road Administration). Tielaitoksen ohjeita 1992. Helsinki, Finland, 1992.