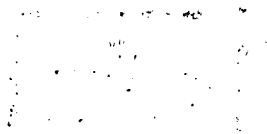# THE UPGRADING OF JEFFERYS TRACK

A METHODOLOGICAL INVESTIGATION INTO THE APPLICATION OF

COST-BENEFIT ANALYSIS TO DEVELOPMENT ROADS

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PREFACE

The proposal that the Lachlan to Crabtree track, now
officially known as Jefferys Track[1], should be upgraded to
allow the passage of cars and trucks has been mooted from
time to time over a long period of years by various local
residents and politicians.

The Derwent Region Transportation Study in its Final
Report (1979) dismissed such suggestions in three short
paragraphs, claiming "....the cost of an all weather all
vehicle route (at least $5.0 m) is too great for the likely
resulting benefits" (p. 58).

Recent events, including the closure of the Australian
Paper Manufacturers pulp-pellet plant at Geeveston and the
subsequent high increase in unemployment in an area noted for
its timber resources, have again stimulated calls for the
upgrading of Jefferys Track to facilitate greater economic
(and social) interaction between the communities in the lower
Derwent and Huon Valleys. The Legislative Council members for
Huon, the Hon. Peter Hodgman, and Derwent, the Hon. Charles Batt,
have both publicly supported the proposal and the Forestry
Commission is at present preparing a confidential report for the
Tasmanian Government on the feasibility of upgrading the route
for use by log trucks.

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[1] Jefferys Track is named in honour of an apparently wealthy and
eccentric Oxford-educated Englishman, Molesworth Jeffrey, who
settled in the Lachlan area after his arrival in Tasmania in the
1830s. See the short article by Gladys Muddle, 1982, "Jefferys Track,"
Tasmanian Tramp, No. 24, pp. 66-69.

* *

I first became aware of the existence of the track some thirty odd years ago when, as a somewhat adventurous youth, I teamed up with a mate to walk through the track from my home town of New Norfolk. We returned by hitchhiking our way along the Huon and Lyell Highways via Hobart; a considerably longer route but in the circumstances, far more comfortable.

I repeated the journey a few years later with another mate (our annual Scouting adventure hike) and, as on the first trip, was deeply impressed by the way in which the two large valley regions, seemingly so far apart when making the trip by road via Hobart, were so close when traversed directly through the Wellington Range. The magic of walking out of the forest onto the steep hill above Crabtree and seeing the vista of the Huon and Channel areas spread out before us was unforgettable. The discovery of a new land; the world beyond the horizon.

* *

But proposals to upgrade primitive bush tracks through rough and hilly terrain are not initiated by the desire to re-create adolescent voyages of discovery. Road works are costly public projects and have to be justified on the basis of perceived social need or economic benefit (since these can be more readily translated into votes). In practice much of the justification used by governments or the community in support of particular road proposals is rhetorical. Slogans

such as "much needed investment", "opening up the country", "creating employment opportunities", "breaking down rural isolation" and others of similar generality form the currency of political lobbying for road programmes.

A more dispassionate approach is provided by the use of various econometric techniques to evaluate the worthiness of projects. Foremost amongst these is the technique of cost-benefit analysis, a technique which has been used (and abused) in thousands of projects in the past twenty or so years.

Cost-benefit analysis attempts to evaluate the "real" costs and benefits of a proposal and, by aggregating them, to arrive at a net value of the project in present monetary terms. In road programmes, cost-benefit analysis has been used to evaluate a large number of proposed projects for which a large unfulfilled travel demand exists. These roads, identified in the thesis as "existing demand" roads are typically urban roads or major inter-city highways. Benefits accrue as time-savings to large numbers of existing road users and other traffic generated by the road improvement. Because the benefits are direct and immediate, the long-term and indirect effects of the project are conveniently ignored, even though there is growing concern that these indirect and induced effects may be quite profound.

The absence of a large and identifiable volume of existing traffic means that cost-benefit analysis is seldom used to evaluate what are defined in the thesis as "developmental" roads. Here the benefits are indirect and long-term and accrue not to existing road

users so much as to potential groups of future beneficiaries.
These benefits unfold as the changing patterns of accessibility
caused by the road create opportunities for people and firms to
exploit for economic and social gain.

Although these effects are potential and uncertain, rather
than direct and visible, the long-term consequences of develop-
mental roads may be very substantial. The construction of the
Pinnacle Road to the summit of Mount Wellington, conceived as
an imaginative scheme to give dignity and labour to unemployed
men during the 1930s Depression, is an example of a develop-
mental road whose benefits to vast numbers of tourists and
day-trippers, as well as disbenefits (negative effects) to
environmentalists, are quite considerable.

The justification for proposing the construction of develop-
mental roads, therefore, rests either with the rhetoric of the
visionary politician or with the paternalism of the bureaucrat
concerned to ensure a transport infrastructure which complies
with the "....minimum socially acceptable level of service...."
(B.T.E., 1984, p. 75).

The following study represents a methodological investigation
into the evaluation of developmental roads using the more
"objective" technique of cost-benefit analysis. The approach is
complicated by two major methodological issues, the normative
basis of the cost benefit model and the lack of any comprehen-
sive understanding of the interaction between transport systems
on the one hand and land use patterns on the other. Even in
urban areas where the transport - land use interaction is more

sensitive and better understood, the classical models of Alonso

and others (Alonso, 1964, Goldberg, 1970, Moses, 1962) depend

on a number of unrealistic assumptions (typically, and most

importantly, a homogeneous physical environment, all employment

concentrated at a single centre - the CBD, and similar tastes

and preferences) to demonstrate the relationship between location

(residential distance from the CBD), density (reflecting the

economic rent earned by land) and accessibility (measured by

journey-to-work transport costs). How much more complicated,

then, for the situation in remote country areas where the quality

of land varies quite markedly, where employment centres are widely

distributed and where accessibility is sought to a number of

dispersed locations.

These methodological issues are dealt with at length in the

thesis and the proposed upgrading of Jeffreys Track is then

examined as an illustrative example of the application of cost

benefit analysis to developmental roads.

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CHAPTER 1   INTRODUCTION

GEOGRAPHICAL SETTING

Jefferys Track connects the two largest and most economically important regions in southern Tasmania, the Derwent and Huon Valleys (Figure 1). Climbing steeply from the Crabtree Road in the Huon Valley the 13 km unsealed track crosses the saddle between White Timber Mountain to the west and Mt. Charles to the east at an elevation of some 700 metres and descends at a more moderate rate towards the settlement of Lachlan in the Derwent Valley (Figure 2). The central 7 km section of the track through the Wellington Range is accessible only to four-wheel drive vehicles. This section, the steepness of the track at the Crabtree end, and the poorly constructed unsealed nature of the road inhibits its present vehicular use to anything other than off-road vehicles, four-wheel drive vehicles, and the occasional timber truck.

The distance from the Crabtree end of the track to the junction of the Huon Highway at Grove, 8 km north of Huonville, is 8 km, and from the Lachlan end to the junction of the Lyell Highway at New Norfolk a further 8 km, giving a total connecting distance between the two highways of approximately 29 km. This compares with the only alternative route between Grove and New Norfolk, via Hobart, of 70 km.

From the highest point of the track a fire trail traverses the ridgeline of the Wellington Range eastwards to Mount Wellington. Accessible only to hikers and off-road vehicles this high altitude trail, rising in places above the 1100 metre contour level, provides

TASMANIA

DERWENT

DERWENT RIVER

VALLEY

New Norfolk

HOBART

HUON

Huonville

HUON RIVER

VALLEY

FIGURE 1

further connections to the peri-urban settlements of Molesworth,
Collinsvale and Mountain River.

Jefferys Track is the shortest and most feasible of four
potential connections between the Derwent and Huon Valleys.
Approximately half-way between Jefferys Track and Mt. Wellington
a steep fire trail crosses the Wellington Range at an elevation of
960 metres between Trestle Mountain and Collins Bonnet providing
a rugged 12 km connection between the settlements of Mountain
River and Collins Cap. To the west of White Timber Mountain a
trail from Judbury via Judds Creek crosses the flanks of Mt. Lloyd
and passes close to Glenfern, west of New Norfolk. Further west
still the possibility exists of a link through the Snowy Range to
connect Lonnavale with Maydena. Although an upgraded Jeffreys
Track would eliminate the need for any further connection through
the Wellington Range, the westernmost link between Lonnavale and
Maydena is somewhat independent of the other routes and may warrant
a separate feasibility study at some stage in the future. Indeed,
if the benefits from upgrading Jefferys Track exceed expectations
this may in itself stimulate pressure to construct a link through the
Snowy Range as a second Derwent-Huon connection. The locations of
the above-mentioned potential road links are shown in Figure 3.

THE FUNCTION OF ROADS

Roads are not only channels of transportation, they provide
access to property and, together with other transport media, form
the arteries of a complex interactive land-use system. Changes in

SOUTH EAST TASMANIA
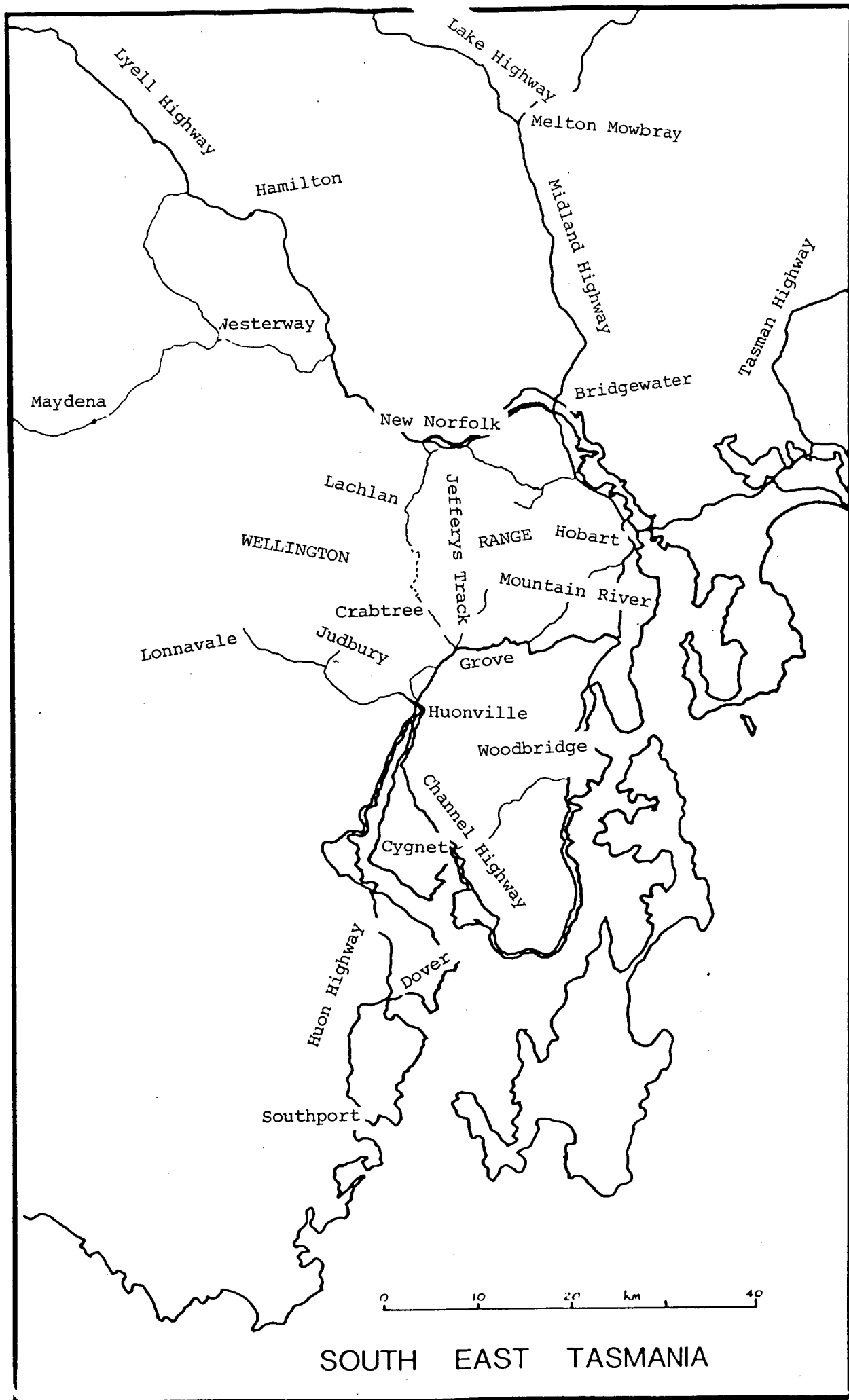
FIGURE 2

the road system alter patterns of accessibility and, consequently, the relative locations of elements of the space economy. These, in turn, cause changes in travel demands and hence, traffic flows. The highly interactive nature of the land-use and transportation systems means that changes in one part of, say, the road system, may eventually lead to quite profound and unexpected changes in land-use patterns and hence the demand for road and other transport services.

Similarly a change in the location of economic activity will lead to changes in the demand for transportation and induce further changes in the interactive land-use and transportation systems.

To study the effects of a road project, such as the proposed up-grading of Jefferys Track, it is necessary to be aware of the long-term ultimate effects of such a scheme as well as the more immediate direct effects to existing road users. Generally one can identify a mix of short-term and long-term effects according to the type of road proposed. At one end of the scale are the road projects for which a clear and substantial transport demand already exists. These comprise by far the greatest number in total and include most urban roads and inter-city highways. Typically such schemes involve proposals for road widening or re-alignment, or the establishment of traffic management procedures, in order to relieve congestion, reduce travel times and cater for projected increases in the volume of traffic. The major beneficiaries of such schemes are the road users themselves who may be subdivided into four separate categories;

(a) the existing users of the road
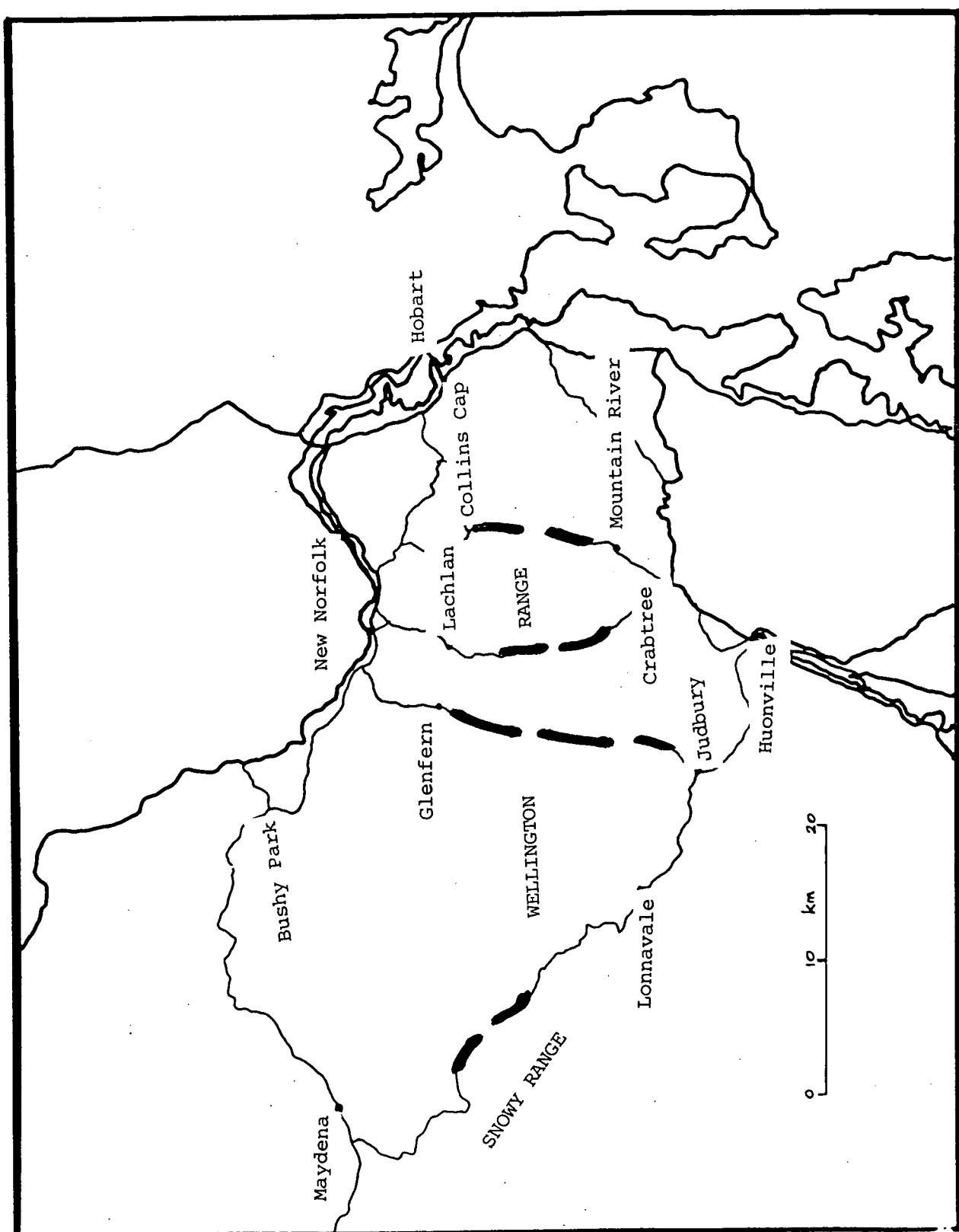
Derwent-Huon Potential Links

FIGURE 3

(b) road users attracted from other roads and/or alternative

     modes of transport because of the road improvements,

(c) travellers remaining on the other roads and/or alternative

     modes who benefit because of the lower volumes as a result

     of the diverted traffic described in (b) above, and

(d) new travellers generated by the improved road or by the

     reduced traffic on the other roads and/or alternative modes.

At the other end of the scale are the road projects where
existing traffic is small or even non existent but where the
potential for future traffic as a result of the induced effects
of land-use changes may justify the road construction. Such
projects may be described as "developmental" roads to distinguish
them from the more common "existing demand" roads described above.
The essential features of developmental road projects are that the
beneficiaries are potential rather than pre-existing and the
benefits are generally indirect and long-term rather than direct
and immediate. In common with many other rural roads in isolated
areas, the proposed upgrading of Jefferys Track may be regarded
as an example of a typical developmental road project.

IDENTIFICATION OF ROAD BENEFITS

The distinction between "existing demand" and "developmental"
road projects determines the ways in which benefits are identified
and evaluated. With the former, benefits are identified as accruing
essentially to road users and are evaluated in terms of time savings,
accident reductions and other traffic effects. With the latter,

benefits are identified as accruing not only to converted and generated road users, but also to the beneficiaries of longer-term land-use changes, and are evaluated not only by traffic criteria but also by changes in land values and other induced indirect effects.

Since both direct and indirect effects flow from all road improvement projects, as a result of the highly interactive nature of the land-use system and the transportation system, the question may be asked; why differentiate between the two types of benefit identification and evaluation? Why not measure the direct and the indirect effects for both "existing demand" and "developmental" road projects?

The answers to these questions involve the methodological problems of double counting the benefits from a road improvement scheme and the difficulties of accurately identifying as well as evaluating the various long-term effects, and separating them from the effects of factors other than the road project.

Because of their impact on the location of economic activity and the pattern of accessibility, all road projects are imbued with externality effects and secondary effects as well as the direct effects to road users. Scitovsky (p. 143) distinguishes two types of externalities, technological externalities and pecuniary externalities. Technological externalities are cases of direct, non-market independence between economic units. The central feature of technological externalities is that the inter-dependence between economic units is outside the market mechanism.

Firms or households which suffer from externalities do not receive monetary compensation, while firms and households which gain do not have to make payments (Dodgson, p. 170). Scitovsky cites two examples of technological externalities that involve the effects of road schemes on the space-economy; the case in which a firm benefits from the labour market created by the establishment of other firms, and that in which several firms use a resource which is free but limited in supply such as a public road subjected to conditions of congestion (Scitovsky, p. 145).

Pecuniary externalities involve interdependence among producers through the market mechanism. Scitovsky argues that in a less than perfectly competitive market investment decisions may give rise to private profitability which considerably understates their social desirability. This, he claims is due to two deficiencies in the operation of general equilibrium theory, the presence of indivisibilities and the static nature of the equilibrium situation. Although there is considerable disagreement as to whether pecuniary externalities as identified by Scitovsky have any allocative effect on the economy (that is, whether or not they alter the productive efficiency of the economy) there is general agreement that they have a distributive effect in altering the inter-personal and inter-regional distribution of income (Dodgson, p. 173).

Both Gwilliam and Dodgson identify a further set of restructuring effects which they term "secondary benefits" (Gwilliam, pp. 170-172; Dodgson, pp. 173-174). Described as

"quasi-Keynsian multiplier effects" these secondary effects
result from the flow-on of direct benefits into other sectors
of the economy.

Although a more detailed analysis of the nature of these
indirect effects is deferred until Chapter 3 (see below, page 31)
it is important at this stage to recognize that the different
types of benefits flowing from road projects cause problems in
defining and measuring the net aggregate effect of the invest-
ment. Externalities and secondary effects take time to work their
way through the economy, and the position is further complicated
by the existence of "intangible" benefits whose precise effects
may be difficult to identify and measure.

For the above reasons the typical economic appraisal of road
projects generally only examines the immediate direct traffic
benefits accruing to road users. Studies largely ignore the
external and secondary effects because of the practical problems
involved in identifying and measuring them, the pragmatic assump-
tion that the indirect effects are relatively minor in their
aggregate effect, and the theoretical concern to avoid the danger
of double counting the original benefits. Although this approach
may be justified in the evaluation of "existing demand" type road
projects where the direct benefits accruing to road users may be
assumed to represent a large proportion of the total benefit, the
traditional approach is inappropriate for the evaluation of
"developmental" roads, such as the proposed upgrading of Jeffreys
Track, where the direct benefits to existing road users may be
only a relatively small proportion of the overall net effect, most

of which is likely to manifest itself in the form of external and secondary effects to land-use changes and future generated traffic.

From a practical point of view it would seem that the most appropriate method of evaluating the benefits from developmental road projects is to take a combination of direct effects, to the extent that they exist, plus the indirect secondary effects, taking as much care as possible to avoid double counting.

CHAPTER 2   OPPORTUNITIES IN THE SPACE ECONOMY

POTENTIAL BENEFICIARIES

As already mentioned, the construction of a new road in rural areas creates opportunities for potential benefits by the restructuring of accessibilities and the consequent rearrangement of land-use patterns. The resultant relative relocation of economic activity leads to changing patterns of demand for transport and alters traffic flows. These in turn induce further changes as the economy attempts to re-adjust to a new equilibrium. Each shift in the system can be regarded as representing sets of opportunities for groups of beneficiaries to capture as they exploit the restructured patterns of accessibility that the road investment brings.

Because of the general lack of pre-existing travel demands, the different sets of opportunities may take varying times to be recognised and exploited. Many people and firms may not initially be aware of a new link or the opportunities it affords. Mental maps need to be re-adjusted, new opportunities explored, and new habits formed, before the full benefits of the road are realized.

In regard to the Jefferys Track proposal a number of potential beneficiary groups can be identified.

The first group consists of those road users who already use the existing four-wheel drive track. This group would obviously benefit from the time savings afforded by the upgraded road, as well as savings in vehicle operating and maintenance costs and

probable reductions in accident risks. The initial substantial benefits may be reduced if, due to increased traffic volumes, reductions in travel time savings and increases in accident risks eventually occur.

A second road user group consists of those who currently use the alternative route via Hobart but who would switch to the upgraded road due to a perceived advantage in using it.

This group includes those who are likely to benefit considerably from the new link ranging down to those who are indifferent to using the new road compared with remaining on the existing road.

There are a number of groups within the category of generated traffic. Foremost amongst them is the group consisting of the local residents in the Derwent and Huon Valleys whose opportunities for interaction as a result of increased accessibility would be greatly enhanced as a result of the proposed upgrading. Again, this group includes those whose potential for interaction would be considerably increased (those in the Lachlan and Crabtree rivulet valleys located at the ends of branch lines in the existing road system), ranging down to those whose potential for interaction would be only slightly increased by the road construction.

The simple branching nature of the road system in Southern Tasmania is indicative of a low level of topological connectivity (Chorley and Haggett, pp. 624-646) and contrasts with the more developed circuit networks of, for example, the North-West Coast.

Residents in these rural areas are isolated in that their
transport links with the outside world are via their respective
valley roads which connect with either the Lyell or the Huon
highway, as the case may be, to take them to higher order places
in the central place hierarchy. The upgrading of Jefferys Track,
as with the upgrading of any of the other potential links between
the Derwent and Huon Valleys, would provide a circuit system
which, in view of the considerable saving in distance compared
with the alternative route via Hobart, greatly increases the
accessibility of residents and opens up considerable opportun-
ities for variations in travel behaviour. The extent to which
these opportunities are taken up, however, depends on the
attractions and complementarities of the various destinations.
Transport is an intermediate service and is undertaken for the
perceived benefits deriving from activities performed either
en route or at the end of the trip. In this respect the
Derwent and Huon Valley communities are similar to each other
and this mitigates against any extensive interaction that might
otherwise be expected to occur if they were more complementary
in character. Lachlan and Crabtree are similar sized settle-
ments approximately the same distance from the higher order
centres of New Norfolk and Huonville respectively. Although
New Norfolk has a considerably larger population than Huonville
(6,243 compared with 1,347 at the 1981 Census), much of this
difference is due to the manufacturing workforce employed at
Australian Newsprint Mills, Boyer. Consequently the two towns

occupy similar positions in the State's central place hierarchy, being almost equidistant from the capital city, Hobart, and having similar functional compositions.

Nevertheless there are still considerable opportunities for interaction not only commercially but also socially and recreationally between the residents of the respective valleys. Importantly, also, is the increased access to employment opportunities that the new road would allow for the generally unskilled and above-average unemployed workforce of the two municipalities.

Opportunities for forestry operations resulting from the upgrading of Jefferys Track are currently the subject of a confidential report being prepared by the Forestry Commission for the State Government. Indeed most of the investigation into the feasibility of the project is being done by the Commission rather than by the Department of Main Roads. This stems from the interest shown in the various alternatives to make use of the forestry concession areas vacated by Australian Paper Manufacturers (APM) following the closure of its plant at Geeveston in the Huon Valley. Interest in these areas is a two-way process. At present logs from the Geeveston area, amongst other uses, are being transported by truck via Hobart to Bridgewater in the Derwent Valley and thence by rail to the Long Reach wood-chip plant in the Tamar Valley. For the Australian Newsprint Mills (ANM) plant at Boyer these rich timber areas could be an alternative source of supply to its own timber concession area in the Florentine Valley. The procedures for allocating forestry resources in Tasmania by means of Statutory timber concession areas, have been recently criticized (Wood and Kirkpatrick, pp. 217-223). Allowing the

unused APM concession area in the Huon Valley to become more

accessible to the Derwent Valley based newsprint manufacturer

ANM may be a convenient way of achieving a more efficient allocation

of Tasmania's timber reserves. The route through an upgraded

Jefferys Track, although steeper and narrower, may be of benefit

to certain log truck operators not only by being shorter in time

and distance but also by avoiding the route through Hobart where

log trucks must contend with considerable locally generated urban

traffic.

Another industrial activity likely to benefit from an improvement

to Jefferys Track is the transport of livestock to and from farms

in the Huon Valley and the main southern livestock sale yards at

Bridgewater. The Huon Valley is an important livestock farming

area and supplies approximately a quarter of the sheep and cattle

traded at the weekly Bridgewater sales. Being some 15 km downstream

from New Norfolk, Bridgewater is more accessible from the Huon

Valley via the Huon Highway rather than Jefferys Track, and therefore

any proposed upgrading of the route is likely to benefit only those

relatively few farms in the Crabtree Rivulet valley.

At a more discretionary level of travel the greatest long-

term benefit of an upgraded Jefferys Track is likely to accrue to

tourists and recreationists. A major feature of tourist behaviour

in Tasmania is the round-Tasmania motoring holiday, or "fly-drive"

package trip, in which visitors from overseas or interstate fly

to Tasmania and then collect a hire-drive vehicle to tour the

State. This accords well with Tasmania's decentralized population and dispersed tourist attractions and helps distribute tourist expenditure to the more remote and non-metropolitan areas of the State. One of the problems with this concept in southern Tasmania is the lack of circuits in the road network. This means that trips from Hobart frequently have to return by the same route, since no other reasonable alternative exists. The Huon and Esperance areas suffer particularly from these "end-of-the-line" disadvantages and rely on the exceptional quality of their environments to encourage tourists to make return day-trips into the area from Hobart. If Jefferys Track was upgraded tourists could "take-in" parts of both the Derwent and Huon valleys, and the Channel district, on their way from west coast to east coast via Hobart, or vice versa.

Another activity with potential benefits arising from the circuit network created by an upgraded Jefferys Track could be the recreational day-trip from Hobart by motorists attracted by the approximately 100 km Hobart - New Norfolk - Huonville - Hobart round-trip (or the less than 200 km round-trip formed by including the Channel loop via Cygnet and Middleton. Such a trip would allow lunch and afternoon tea stops to be taken at New Norfolk and Huonville and contribute to the local economy.

The establishment of an accessible road over Jeffreys Track is also likely to lead to an increase in hiking, which would

need to be carefully controlled so as not to conflict with
the conservation of the area, on routes through the Wellington
Range. At present, because of its relative inaccessibility,
the Wellington Range is probably a blank spot on most peoples'
mental maps of the Hobart area apart from the obvious landmark
of the summit of Mt. Wellington. The relatively short north-
south link through Jefferys Track, providing magnificent vistas
of the Derwent and Huon Valleys, is likely to excite the interest
of many Hobartions and encourage them to explore the other
dolerite-capped peaks which form the ridge-line of the Wellington
Range.

A final group of beneficiaries are the non road-users, those
residents and businessmen who derive benefits from the extern-
alities and secondary effects flowing through into the regional
economy from the direct benefits derived from the road invest-
ment.

Although most benefits (small and intangible though many
of them may be) are positive, it must also be recognized that
an upgrading of Jefferys Track is certain to inflict negative
benefits, or disbenefits, on various groups of people. Increased
traffic volumes increase the risks of accidents, pollute the
air with noise and exhaust fumes, and generally disrupt the
peace and tranquility of what are at present out-of-the-way
isolated rural valleys. Obviously many local residents prefer
things the way they are and are likely to suffer a loss of
amenity if that isolation is disrupted too greatly. Any

comprehensive evaluation of the proposal to upgrade Jeffreys

Track must take into account the sets of disbenefits as well

as the more obvious benefits that are likely to flow from

the project.

METHODS OF PROJECT APPRAISAL

Roads are public projects and as such compete with other

potentially fundable public projects for society's scarce

resources. Decisions as to whether this or that public project

should be allocated resources, and to what extent, are made by

governments acting within the constraints of their political

programmes. The scarcity of resources and the limitations of

public expenditures ensure that not all projects, no matter

how potentially beneficial they may be, can be funded. Priorities

need to be established and criteria adopted in order to evaluate

the worthiness of any particular project in comparison with

other alternative projects.

The ways in which decisions are made in practice are

numerous. Governments may act for perceived electoral gain or

to repay sectional interests or in response to pressures from

various groups in society. They may act from paternalism,

regarding themselves as better judges than the individual of

what is "best" for society, or from necessity, in the provision

of public goods (Kolsen and Stokes, p. 20). Notwithstanding

their ultimate power to determine in their own way the "public

interest" in regard to the evaluation of projects, governments

have on many occasions sought to base decisions on more
objective and comprehensive criteria than mere political judge-
ment. In this context the employment of an approach known as
cost-benefit analysis has gained wide popularity as an evalua-
tion technique for public projects. Based on an assumed
aggregation of individual preferences, cost-benefit analysis
seeks to sum the various streams of costs and benefits incurred
by, and accruing to, members of society and to express the net
worth of the proposed project in terms of present monetary
values.

Although the methodology of cost-benefit analysis will be
dealt with more thoroughly in Chapter 3, it is as well at this
stage to emphasize the normative basis of its fundamental
assumptions in order to keep in proper perspective the often
implied assumption that the use of cost-benefit analysis is
purely an exercise in positive economics.

In this respect it is important to differentiate between
the methodological problems of identification and measurement
that lie within the paradigm of the model, and the normative
political-economic character of its conceptual environment.

It is not appropriate here to discuss all of the criticisms
of the philosophy of cost-benefit analysis, of which there are
many (see, for example, Mishan, 1981), but merely to point out
some of the major problems. Of fundamental importance is the
notion of "welfare", a term which cannot be defined unambiguously
without recourse to a belief in a particular type of political

economy. The political economic model determines legal rights, particularly in regard to property, and specifies amongst other things, the characteristics of a mechanism for allocating resources. It is only when these features of a particular political economy are accepted as axioms that derived concepts such as "welfare", "equity", "optimum", and so on, are able to be defined.

Even within these parameters there are ambiguities in regard to states of welfare optima. The well-known Scitovsky paradox is discussed by Pearce (p. 8), while Mishan in noting the indeterminancy that gainers can potentially compensate losers in moving from state 1 to state 2, but the compensated losers can bribe the gainers into returning to state 1, concludes that "....in principle an optimum allocation of resources is neither actually nor potentially superior on welfare grounds to a non-optimum allocation of resources" (Mishan, p. 4).

In discussing the ideology of rational choice and objectivity, Tribe criticises the concept of the "classical utilitarian" who "....conflates all persons into one....and all goods into the production of a single good - individual satisfaction - whose maximization over the sum of all persons becomes the sole end of rational policy. Such a vision is an inescapably ideological one and lies at the core of 'cost-benefit' analysis, with 'total net benefits' serving to replace the concept of total individual satisfaction" (p. 22).

Tribe also criticises the way variables are added together as "....a perfect illustration of the tendency in economics and

policy analysis to reduce complex structures to an unstructured set of components rendered comparable by simple exchange rates or indifference functions. Specifically, the theory must assume either that individual preferences may be expressed as simple summations of the total bundle of goods the individual enjoys; or that social preferences should be arrived at through some continuous aggregation of individual satisfactions" (p. 24).

Finally, Williams points out the inevitable bias in the choice of variables used to measure costs and benefits. Those which an economist may regard as being important to an objective evaulation of a project may not be those chosen by, say, an urban planner or a sociologist. And, of course, a bias towards those variables which are easily quantified in money terms or for which surrogate measures can be easily constructed are an inevitable feature of practical applications of cost-benefit analysis (Williams, p. 56).

The above criticisms of the philosophical basis of cost-benefit analysis are not intended to suggest that the model is inappropriate as a tool for project evaluation. On the contrary, provided the ideological basis of the cost-benefit paradigm is explicitly recognized and it is not treated quasi-religiously as a value-free black box generating politically neutral evaluations, the model can be used effectively as a sophisticated and valuable aid to rational decision-making.

In Chapter 3 the methodology of cost-benefit analysis and its application to road investment projects are examined in more detail. Chapter 4 then evaluates the costs of upgrading

Track, while Chapter 5 considers the measurement of benefits

accruing to the various beneficiary groups. An overall

evaluation and a summary of the application of cost-benefit

analysis to developmental roads is presented in Chapter 6.

CHAPTER 3   THE APPLICATION OF COST-BENEFIT ANALYSIS

TO ROAD PROJECTS

COST-BENEFIT ANALYSIS: METHODOLOGY

Cost-benefit analysis is concerned with an evaulation of the economic efficiency and the resource allocation implications of public projects. As such it stands between the broader social technique of policy analysis, incorporating the particular proposed project within the context of a more encompassing strategy of public policy and equity considerations, and the financial appraisal studies used to evaluate the pecuniary effects of purely private transactions.

The projects to which cost-benefit analysis is applied are typically single projects or programmes in which the domain of potential sets of beneficiaries can be more or less circum-scribed, but for which externalities and other aspects of market failure preclude a purely financial appraisal. As such, road proposals present themselves as classic examples of public projects amenable to cost-benefit analysis evaluation.

The basic concept of the cost-benefit approach is a simple one; a particular public project is justified if, when con-verted to present monetary values, the sum total of its various benefits outweighs the sum of its costs. The difficulties associated with the approach, however, stem from those very same simple concepts; which costs and benefits to include, how to

evaluate them, and how to aggregate them to arrive at a single net social value?

The approach adopted is to combine the neo-classical model of efficient resource allocation with an appropriate welfare function. Starting with the simplest two-input, two-ouput, two-person world in which the inputs are homogeneous, perfectly divisible, and inelastically supplied, the outputs are homogeneous goods derived from production functions with constant returns to scale and diminishing marginal rates of substitution for each level of output, and the two persons possess ordinal preference functions reflecting unambiguous and consistent preference orderings of all conceivable own-consumption combinations of the two goods, it is easy to demonstrate that the purely technical problem of the most efficient allocation of resources is obtained at the point where the marginal rate of transformation of one good for another exactly equals the marginal rate of substitution between the goods as consumption items (Bator, p. 26).

By incorporating a welfare function, characterized by the normative Pareto criterion that welfare is increased if one person can be made better off without any other person being made worse off, it is possible to show that a duality exists in which the optimisation of the technical transformation and utility functions coincides with the optimum welfare function to produce a static equilibrium solution (Winch, p.27). This in turn leads to the identification of the perfect competition

model as the market mechanism which leads to optimality and the adoption of marginal cost pricing as the means of allocating resources.

The rigid Pareto criterion of identifying increases in welfare as a gain to somebody without a loss to any other person was modified by Kaldor in 1939 to allow for a net welfare gain if certain people lose but are compensated for their loss by the greater gains of those who benefit, and by Hicks in 1940 who argued that it was necessary only for the possibility of potential compensation, rather than actual compensation, to exist. Such modifications assume, inter alia, an optimum income distribution. The Kalder-Hicks criterion has been adopted into modern welfare economics as a potential-Pareto improvement condition.

Given these conditions, net gains to social welfare are obtained by adding and subtracting changes in consumers' surpluses resulting from price changes caused by the investment. Consumers' surplus represents the value to consumers of the opportunity to buy units of a good below the maximum price that they would be prepared to pay for the benefit, and is measured by the area between the price line and the compensated market demand curve. (Sugden and Williams, p. 116).

There are several problems associated with the use of consumers' surplus in project evaluation in general, and in transport investments in particular.

In order to avoid the Scitovsky paradox whereby the difference between the sum of money an individual would need

to just compensate for an adverse effect of a project and the sum that he would just be willing to pay to reverse this effect leads to two alternative and simultaneous "states of the world", it is necessary to adopt the "zero income effect" assumption (Sugden and Williams, pp. 130-131). That is, it is necessary to assume that price changes resulting from, say, a transport investment do not lead to a change in demand for transport services. This assumption can only be justified for small price changes which have negligible income effects, a situation which is not the case with many transport investments.

A further problem is that consumer surplus calculations are inappropriate when dealing with externalities and other market imperfections. "When we consider that the external effects of a transportation improvement are in many ways more significant than the improvement itself, this seriously calls into question the use of consumer surplus in such applied problems. To further complicate the problem, these external effects are not static, but rather induce a variety of second and higher order effects over time". (Goldberg, 1972, p. 341).

APPLICATION TO ROAD PROJECTS

Roads are common user facilities characterized by conditions of jointness, varying degrees of congestion, and a wide range of private costs and benefits.

The interrelationships between the road system on one hand
and the land-use pattern on the other create difficulties in
circumscribing the domain of direct and indirect effects caused
by investment in road projects, and thus the set of benefits
and disbenefits that need to be evaluated in any social cost-
benefit analysis.

To take too narrow a definition of relevant effects may
lead to the neglect of important and far-ranging consequences
of a particular road project. On the other hand to take too
wide a view may open up the analysis to areas in which the
enumeration of benefits is dominated by hosts of obscure and
difficult-to-measure secondary effects.

To explore these issues further it is necessary to con-
sider the general purposes for which road investment projects
are funded. At their most modest level, roads may be regarded
as providing specific direct transport benefits to those
motorists who use them. However, even at this level roads can
seldom be considered in isolation. They form parts of networks
and must be linked to other roads in the system, and so impact
on the surrounding land-use system.

At the other end of the spectrum road projects may be key
elements in far-reaching programmes of regional development.
In such cases the wider impacts of road projects on population
growth, economic activity and land-use patterns are more
obviously explicit and recognized.

It is because of their potential impact on land-use patterns

and their role in regional development that the allocation of resources by governments to road programmes is not generally determined by normal supply and demand criteria.

The Bureau of Transport Economics (1984, p. 75) claims that the basic road system may be regarded as a "merit good". Thus many roads in rural areas are provided at standards not warranted by the benefits accruing to the relatively few people who use them, on the grounds that the provision of roads of an appropriate standard conforms to a minimum socially acceptable level of service. Similarly, consider-ations of national prestige may play an important part in decisions to allocate resources to national highway programmes over and above what may be justified on purely traffic demand criteria.

The non-economic basis for allocating resources to roads invalidates criteria for assessing the merits of particular road projects by techniques concerned with economic efficiency such as cost-benefit analysis. However, Kolsen and Stokes argue that "....the commitment of versatile resources becomes more manageable and a more practical possibility if some constraints are accepted....An efficient solution constrained by allocation of funds still requires selection of the 'best' projects in terms of benefit creation per dollar of expenditure..." (p. 22-24). In this respect they differentiate the practical techniques of benefit-cost analysis (sic.) from the theoretical limitations of welfare economics. While welfare economics

"....can make some unequivocal directives for the most
efficient use of resources when enough assumptions are made,
some of which assume circumstances very different from those
actually in existence....benefit-cost analysis can be applied
in the imperfect, inefficient world". (p. 27)

The acceptance of constraints in the allocation of
resources to roads as "merit goods" removes from the cost-
benefit evaluation the wider consideration of what should be
the optimal allocation of resources to a particular road
project given all the other alternative uses to which the
resources could be applied. Provided the resources are
potentially available within the appropriate budget area,
the cost side of the cost-benefit evaluation becomes merely
the net present value of the resources needed to construct and
maintain the road to its particular specified design standard.

It is on the benefit side of the equation (adopting the
conventional practice of defining adverse effects as negative
benefits, or disbenefits, rather than as costs) that the
methodological problems become conceptually diverse and open
ended.

As mentioned earlier, the traditional, pragmatic approach
to road investment evaluation adopted by authorities such as
the Australian Bureau of Transport Economics (B.T.E. 1972,
B.T.E. 1984), the U.S. Bureau of Public Roads, and the British
Ministry of Transport and Road Research Laboratory (Gwilliam,
pp. 167-168) is to measure only the direct road-user benefits
and to largely ignore the external and secondary effects that

flow from them. Undoubtedly this approach is adopted because the above authorities are involved in evaluating "existing demand" projects; that is, those roads where there is already a substantial volume of traffic and where the greater proportion of benefits will accrue to existing road-users. The flow-on secondary effects and external effects can be dismissed, usually with an appropriate acknowledgement that they exist, on the practical grounds that they are assumed to be relatively unimportant, and on the theoretical justification that to include them would be to double count the direct road-user benefits.

Both Gwilliam (p. 168) and Harrison and Holtermann (pp. 214-216) argue strongly against such a dismissive treatment of the secondary and external effects and give serious attention to the impact of such effects.

Gwilliam argues that to base a road investment appraisal on the calculation of direct vehicle-user benefits carries a dual implicit assumption:

(i)   that actual traffic benefits can be correctly anticipated and predicted, and, even if this is so,

(ii) that the traffic benefits are a reasonable proxy for the total benefit.

These assumptions, he claims, neglect:

(i)   changes to actual traffic patterns arising because of unpredicted changes in economic structure, and

(ii) the effects of externalities.

The question is further complicated by the regional question. Transport user benefits might give a reasonable proxy for total benefit to the economy as a whole but yet, because of pecuniary externalities, give a poor indication of the regional distribution of benefit. (Gwilliam, p. 168).

Harrison and Holtermann argue that externality effects underpin the whole concept of physical land-use planning and that it is misleading for a transport evaluation to be concerned only with changes in transport costs. "Thus, those very effects which transport appraisal might dismiss as irrelevant to a measure of benefit are the very kind of effects which physical planning is concerned to promote or prevent" (p. 215).

To understand the significance of these arguments it is necessary to discuss the nature of the various indirect effects in more detail.

EXTERNALITIES

The nature of technological and pecuniary externalities has already been described (see above, page 5). Some technological externalities resulting from road projects are already incorporated in present appraisal procedures. For example, wherever a road investment causes diversion from one route to another, thus reducing congestion, external economics exist as benefits to the road users remaining on the less congested road. These benefits are evaluated in conventional

cost-benefit analyses as time savings and possibly, reduced accident risks to the road users.

Other technological externalities, however, are not evaluated. For example, a new road investment may increase labour catchment areas, permitting a more efficient utilization of labour resources. Similarly, the growth of one firm, or of an industry, as a result of the road investment, may increase the size of market for others and permit them to expand to such an extent that internal economies can be fully exploited (Gwilliam, p. 169).

In general, technological externalities have a greater potential for realization in underdeveloped regions where the opportunities for firms to achieve economies of scale and to employ currently underutilized resources are greater than in more developed regions.

Pecuniary externalities are a more contentious issue. The examples put forward by Scitovsky (pp. 145-151) are summarily dismissed by Mishan as being nothing more than "....such diverse phenomena as consumers' and producers' surpluses, unexploited investment opportunities to be found in complementary industries... in decreasing cost industries..., or in domestic import-competing industries...." (p. 136). Most other writers agree that pecuniary externalities are merely transfers with no net effect on aggregate social welfare. For example, "....road investments may increase the attractiveness of, and hence the demand for, some locations with the result that land prices rise. But such rising transfer costs are merely economic rents which constituted a redistribution of benefit but not any extra benefit over and above the transport

cost advantages which cause them" (Gwilliam, p. 169). Similarly, Sugden and Williams make the point that with pecuniary externalities, "....one person's gain...exactly offsets another person's loss...." (p. 144).

Notwithstanding their lack of effect on aggregate welfare, pecuniary externalities are recognized as having an effect on the distribution of welfare as between different people and between different regions in the space-economy (Sugden and Williams, p. 207; Dodgson, p. 173), and this may be an important consideration in particular projects, such as with developmental roads.

SECONDARY EFFECTS

The argument in regard to pecuniary externalities that "one person's loss is another person's gain" neglects the re-organization of the economy that takes place when cost savings resulting from a road investment are passed on as intermediate goods in production. In this case relative factor and product prices will change and consequently factor and commodity substitutions will occur, according to their elasticities of demand and their sensitivities to altered transport costs.

Gwilliam (p. 171) considers a simple model in which transport is a primary factor of production. Assuming complete regional specialization of production, constant returns to scale in production, and equal factor returns in different sectors, a reduction in transport costs resulting, say, from a road investment leads to a number of re-organizational effects. Of greatest

significance, Gwilliam claims, is the elasticity of factor supplies.
If factor supplies are elastic then an increase in output would
take place in excess of the reduction in transport costs. Prices
of transport-intensive products will fall and if there is a high
degree of cross-elasticity of substitution within non-transport-
intensive products this will lead to a high ratio of final benefit
to the initial transport benefit. A similar substitution will
take place in the factor market with transport-intensive factors
displacing non-transport-intensive factors.

If the assumptions of regional specialization, economies of
scale, and factor mobility are relaxed, the situation becomes
even more complex. The market areas for those producers having
lower production costs can be expected to increase at the expense
of those producers with higher production costs, and this leads
to increased regional specialization (see Figure 4b). The
existence of economies of scale and factor mobility accentuate
the advantage accruing to those firms deriving the greatest
benefit from the initial transport cost reduction (Figure 4c).
Gwilliam concludes, therefore, that:

"We would expect a high incremental output/transport benefit
ratio to be associated with

(i)   High elasticity of factor supplies.

(ii)   High substitutability of inputs.

(iii) High product substitutability.

(iv)   Extensive economies of scale.

(v)   Low initial level of regional specialization of production.

(vi)   High factor mobility." (p. 172).
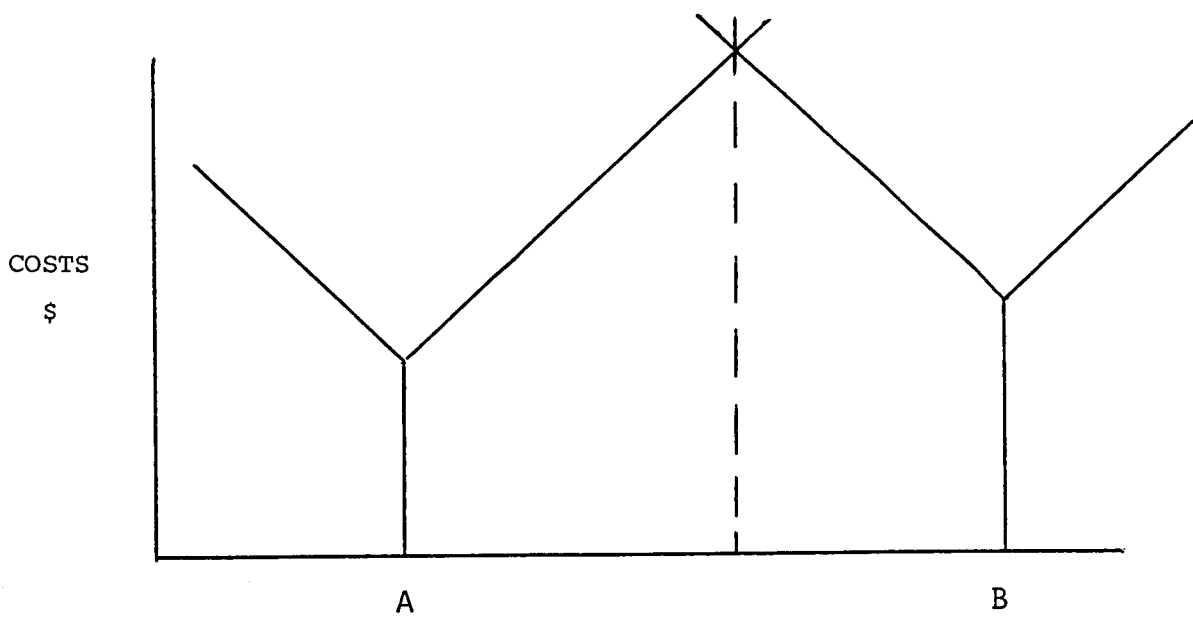
(a) Initial Situation

A's production costs are lower than B's (vertical lines)

Both firms have the same transport costs (oblique lines)
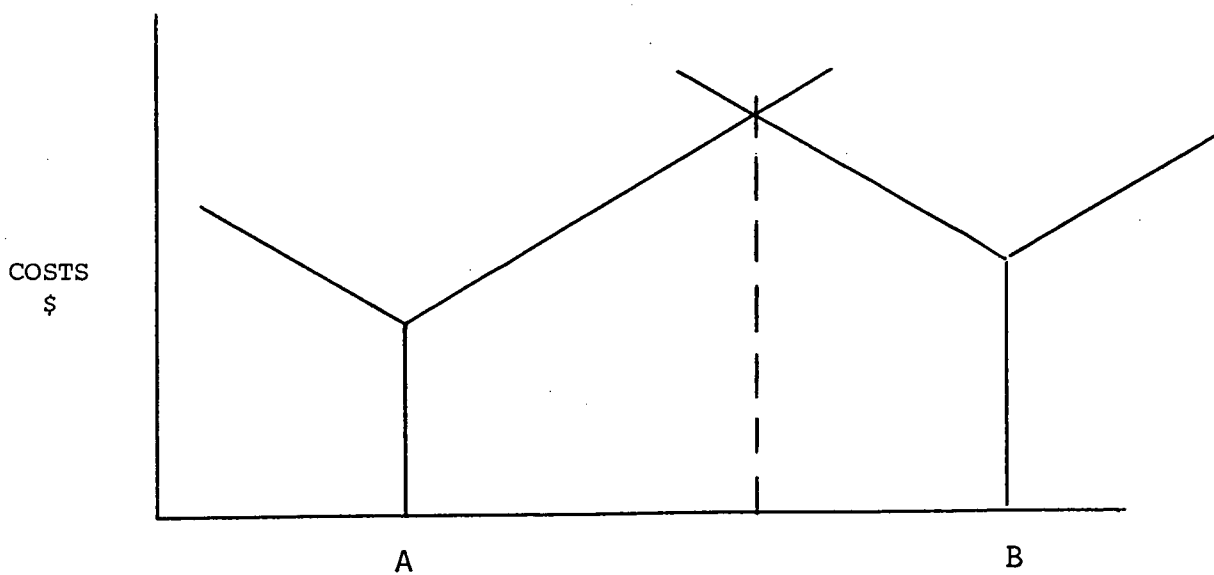
(b) Reduction in Transport Costs

A's lower production costs enables him to increase his market area at the expense of B.

FIGURE 4
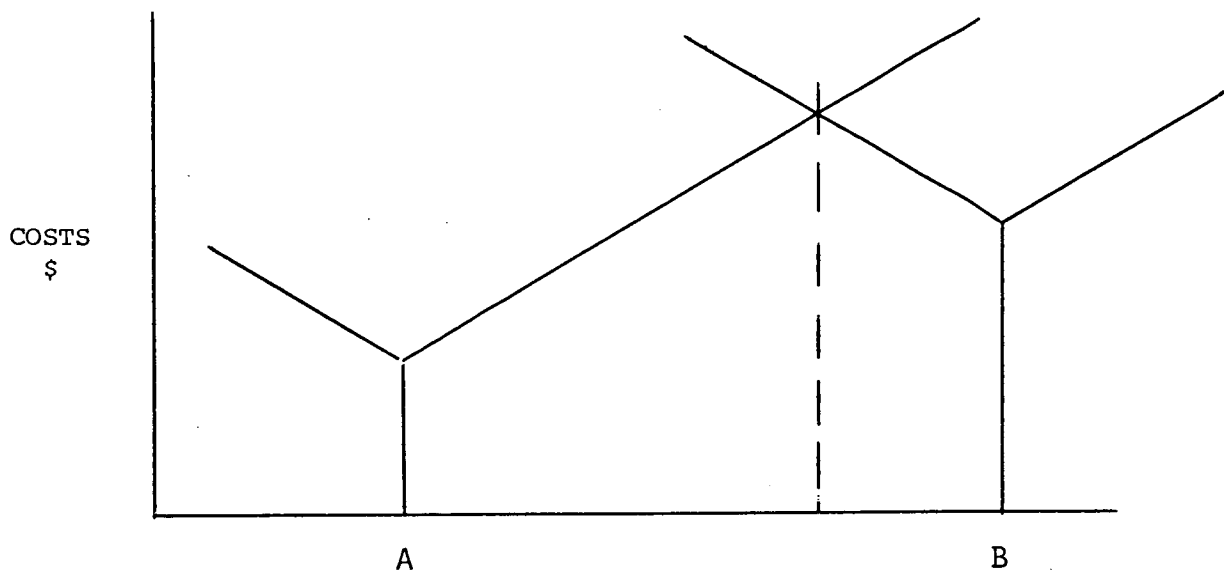
(c) Economies of Scale

 A's increased market area decreases his production costs

 B's decreased market area increases his production costs

 A's market area expands still further
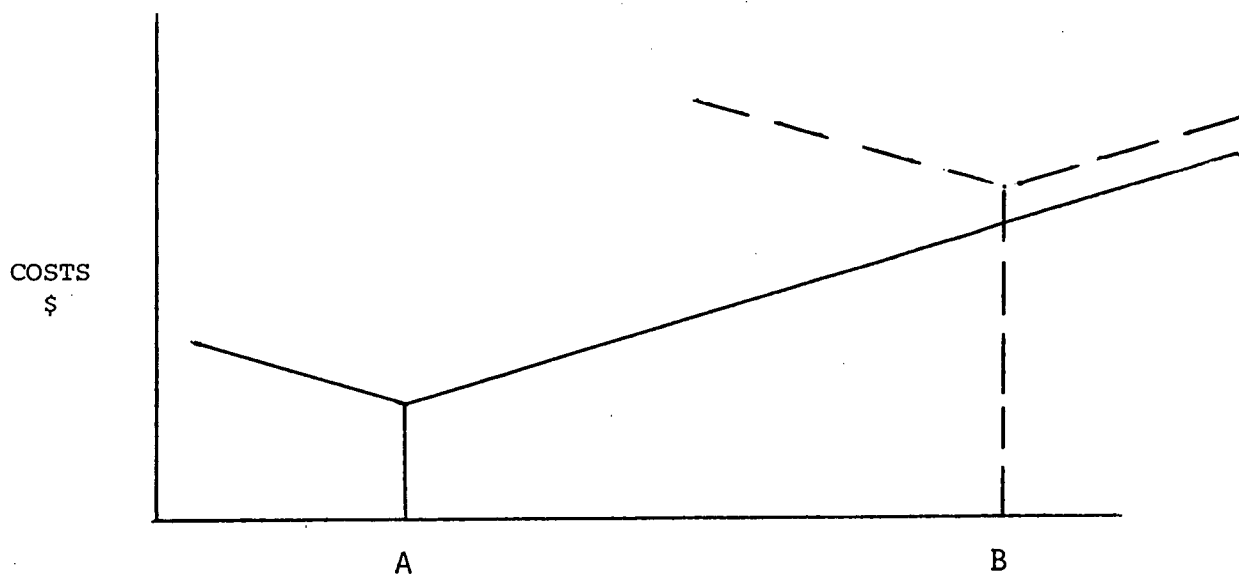
(d) Market Capture

 The combination of reduced transport costs and economies

 of scale may enable A to capture all of B's market

FIGURE 4 (CONTINUED)

The degree to which firms are able to exploit transport cost savings has an impact on the regional location of industry. For example, an area with a high level of unemployed labour, provided it has the appropriate skills or can be trained, may benefit from the reduction in transport costs due to a higher elasticity of labour supply, whereas, on the other hand, a more developed region may benefit from being able to exploit agglomeration economies and economies of scale.

Despite the obvious multiplier effects of secondary benefits and their important implication for regional inequalities there are, nevertheless, serious conceptual and practical problems in evaluating their net aggregate effect (Gwilliam, p. 174). A fundamental problem is trying to separate those changes due to the road investment from those due to other causes. This is particularly important given that many changes may be associated with varying lead times and may not filter through the economy until well after the initial transport benefits have been incurred. A final problem is the difficulty of obtaining relevant data in order to give reliable estimates of the wide range of effects that are subsumed under the category of secondary benefits. To this end several writers have advocated the use of land values as a measure of the final benefits from road investments, arguing, as does Saccomanno, that "through site value transfer, benefits and disbenefits of a given transport programme are reflected in capitalized form in site value changes on land". (p. 170).

CHANGES IN LAND VALUES

According to Goldberg: "Improvements in transportation and therefore accessibility are quickly capitalized in site rents" (p. 340). Although he was referring to the urban environment where the relationships between transportation and the land-use system are more sensitive, due to the greater marginal rate of change of land values, the observation is sufficiently general to apply to the impact of developmental roads in rural areas.

Saccomanno regards the valuation of the spatial distribution of investment impacts on residential and productive land as an acceptable alternative to the conventional approach of using consumers' surplus, "....since it circumvents many of the difficulties associated with traditional welfare economies.... By perceiving investment impacts indirectly through changes in the land market, the analyst can forgo the relatively uncertain exercise of valuing intangibles" (pp. 169-170). Site value is defined by Saccomanno as: "The capitalized sum of differential rent payments over a given investment stream", and represents the value increment that accrues to a unit of land as a result of its locational advantage.

Mohring developed a model to show that reductions in transport costs lead not only to changes in site rents but also to a lowering in intensity of land use. Sites further out, as a result of the transport cost savings, are just as accessible as sites closer in prior to the road improvement. Thus the benefits to land values are redistributed differentially

throughout the region. Mohring's purpose in examining the
relationship between land values and transport savings, however,
was to use the former to estimate the value of travel time rather
than to evaluate the aggregate effect of the transport investment.

The translations of consumers' surplus from transport benefits
to site values is impeded by imperfections in the land market. The
most difficult problem is that of isolating the road improvement
effects on land values from all other factors that might influence
land values. Many behavioural and institutional relationships will
have an effect on the road investment-land use nexus. These include
such diverse considerations as property tax effects, externalities,
site improvements, zoning and migration (Bahl, *et al.*, p. 272).

In order to forecast the results of a project it is necessary
to know enough about the determination of land prices to be able
to forecast not only what changes would occur in any event but
also what will be the impact of the project being analysed.

Holsman identifies three broad groups of price information
from which inferences about land prices can be drawn; house
prices, rents of shops, offices and other business premises, and
prices of agricultural land. Unfortunately, "....none of them
reflect land prices proper, since they are prices paid for the
use both of sites and of structures on them...." (p. 18). What
is needed is to distinguish the element of price paid that relates
to the structure from that which relates to the site itself.

The movement of property values over time is an even more
intractable problem. The effects of road investments on land
use changes are seldom immediate, so that to trace them through
property values it is necessary to compare the change over time

which did occur with the assumed change that would have occurred
in their absence.

SUMMARY OF THE ARGUMENT

To recapitulate; changes in the road system alter patterns
of accessibility and this leads to changes in land-use, travel
demands, and traffic flows. These in turn induce further rounds
of changes to patterns of accessibility, land-use and traffic as
the economy adjusts towards a new equilibrium. Consequently, the
effects that flow from road investments are a combination of
direct benefits to road users plus external effects and induced
secondary or re-organizational effects.

Road proposals typically fall into two types:

(a)   "existing demand" roads, where the proposed improvements
       are designed to relieve congestion and improve traffic flow
       in order to provide direct and immediate benefits to large
       numbers of existing road users, and

(b)   "developmental" roads, where existing traffic volumes are
       low but where there is potential for future traffic growth
       as a result of the land-use changes induced by the road
       construction.

The applications of cost-benefit analysis to road projects
have traditionally been applied to "existing demand" type roads,
such as roads in urban areas and major inter-city highways.
Decisions to construct developmental roads, on the other hand, have

usually been made on the basis of perceived public need, as "merit goods".

In the traditional cost-benefit evaluation of roads only the direct road user benefits are appraised. External and secondary benefits are usually ignored on the basis of practicality and to avoid double counting. This approach may be valid for "existing demand" type roads where direct road user benefits are assumed to represent a large proportion of the total benefit; although even here the unaccounted combined external and secondary effects may, in some cases, be very considerable. With "developmental" roads, however, the external and secondary effects comprise by far the greater proportion of the total benefit, and therefore the traditional approach of measuring direct road user benefits is inappropriate.

Attempts to trace the flow-on effects of road schemes are, however, fraught with difficulty. Changes in land values are potentially a means of evaluating the benefits flowing from "developmental" roads but these are bound up with other factors which influence land use, and are further complicated by the differential spatial and temporal rates at which the impact of secondary effects take place as well as imperfections in the land market.

In the following two chapters an attempt will be made to measure the costs of constructing a rural developmental road in southern Tasmania, the proposed upgrading of Jeffreys Track between Lachlan and Crabtree, as well as presenting a methodological

investigation into ways of evaluating the potential benefits

flowing from the scheme.

CHAPTER 4   JEFFERYS TRACK UPGRADING: COST ESTIMATES

ROUTE STANDARDS

The extent to which the potential opportunities in the space
economy, identified in Chapter 2, are able to be realized depends
primarly on the standard to which the road is upgraded. Design
standards include the condition of the road surface (whether sealed
or unsealed), the nature of cuttings and bridges, and parameters
governing gradients, curvatures, line of sight, road width, road
markings, and associated road furniture. These considerations in
turn depend on the physical environment through which the road
passes; altitude, aspect, slope, type of bedrock, susceptibility
to hazardous environmental conditions such as frost, ice and snow,
and so on.

Increasing the standard of upgrading necessarily incurs
additional costs as well as expanding the opportunities for
additional benefits. If road upgrading standards were infinitely
divisible, the optimum quality of road standard would be deter-
mined by the point at which the increasing marginal road cost
just equals the decreasing marginal benefit of road use.

In practice, however, road standards are highly indivisible,
in contrast with the continuous nature of changes in travel demand,
and are determined by various State and national conventions.
Thus; "The criterion to be applied in moving from one standard
to another (say unsealed to sealed, or two lanes to four) must,
of necessity, be set at some (relatively) fixed traffic level

although the traffic load on the road is changing continuously.
It is practically impossible to change a road incrementally to
match a changing traffic pattern, changes always result in some
quantum leap in capacity or quality" (B.T.E., 1984, p. 16).

In Tasmania, roads are officially classified under five
categories; Highways, Main roads, Development roads, Tourist
roads, and Secondary roads (B.T.E., 1984, p. 5). However,
these categories reflect historical and political criteria
rather than the quality of road standard as such. In current
practice new and upgraded roads are constructed to one of two
major standards, State Highways or non-State Highways, with
modifications to each to allow for average daily traffic (ADT)
volumes and difficult terrain (see Figure 5).

JEFFERYS TRACK AND ASSOCIATED LINK ROADS

As mentioned earlier, roads are parts of networks and
therefore a proposal to upgrade any particular road carries
with it an obligation to consider the standards of other
roads directly linked to it. In the case of Jefferys Track it
is connected to the Lyell Highway at New Norfolk and to the
Huon Highway at Grove by a series of varying standard secondary
roads. From north to south, the difficult sections and their
respective lengths are shown in Table 1. Photographs of parts
of the sections, showing their general condition and the nature
of bridges, verges and road surfaces are also shown, as
Figures 6 to 8.

NEW NORFOLK TO GROVE

LINK ROAD SECTIONS

Section	Length (km)
Lachlan Road	8.0
Jefferys Track - Unsealed	6.0
Jefferys Track - "Missing Link"	7.0
Crabtree Road - Unsealed	3.0
Crabtree Road - Sealed	5.0

TABLE 1

(a)   Gravel road connecting Lyell Highway and Lachlan
      Road east of New Norfolk

(b)   Lachlan Road between New Norfolk and Lachlan.
      Painted centreline;   broken edges;   slippery verge

FIGURE 6

A short, less than 1 km, section of gravel road connects the Lyell Highway with Lachlan Road directly and enables traffic to and from Hobart to by-pass New Norfolk. The quality of Lachlan Road, although sealed, is generally poor with a narrow 4 metre wide carriageway, broken edges, and deteriorating wooden bridges. Although shown to change classification from a secondary to a minor road south of Lachlan hamlet ("Collinsvale" sheet, Tasmania 1:25,000 series, Tasmap No. 5025) no real discernible change in road quality occurs until the start of Jeffreys Track, the first 6 km of which is narrow, steep and unsealed, but relatively easily negotiated by car.

From the other end, the section from Grove to just past Crabtree is of better standard than the Lachlan Road and, apart from one or two narrow bridges, is well sealed with a 5.5 metre carriageway. From this point, however, the unsealed road deteriorates rapidly with loose edges and frequent pot- holes. Mitchells Road is steep, narrow, and rutted, and soon becomes impassable to other than four-wheel drive vehicles.

The 7 km central "missing link" section of the track is, from a road construction point of view, formidable. The high elevation (up to 700 metres above sea level), combined with steep gradients on the shaded southern flanks and outcrops of resistant bedrock, pose severe problems for both the alignment of the road and the construction of its reservation. In practice, the Department of Main Roads (DMR) attempts to construct a reservation that is wider than the initial require-

ADT < 3000: Pavement Width 6.0

ADT > 3000: Pavement Width 7.0
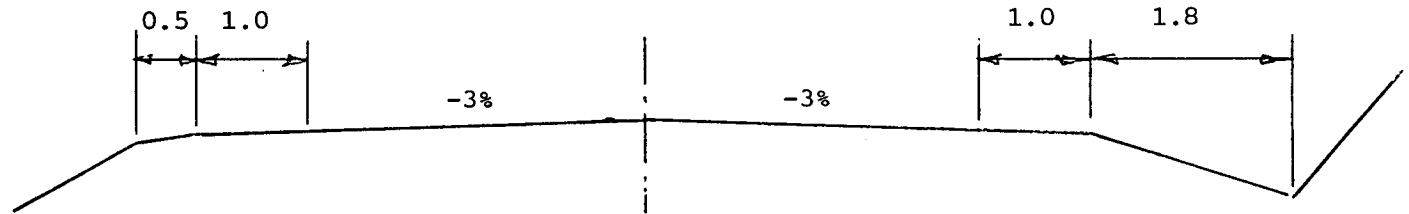
(a) Normal Application

(b) Where economy demands
     e.g. cuttings in solid rock

FIGURE 5

(Source: Department of Main Roads)

ADT > 300:   Pavement Width 6.0

(a)   Normal Application

ADT < 300:   Pavement Width 5.5
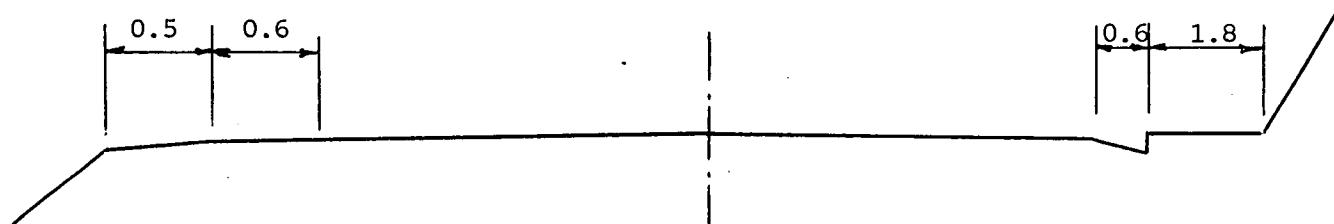
(b)   Normal Application

FIGURE 5 (CONTINUED)

(Source: Department of Main Roads)

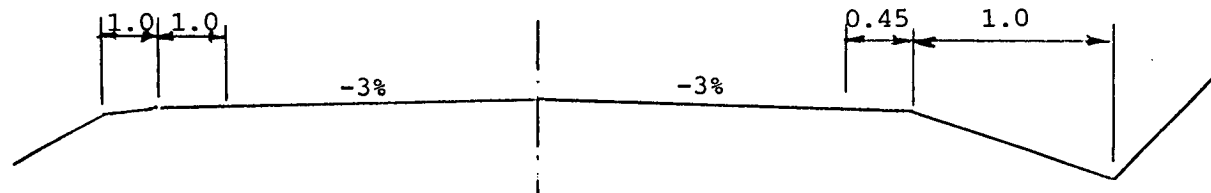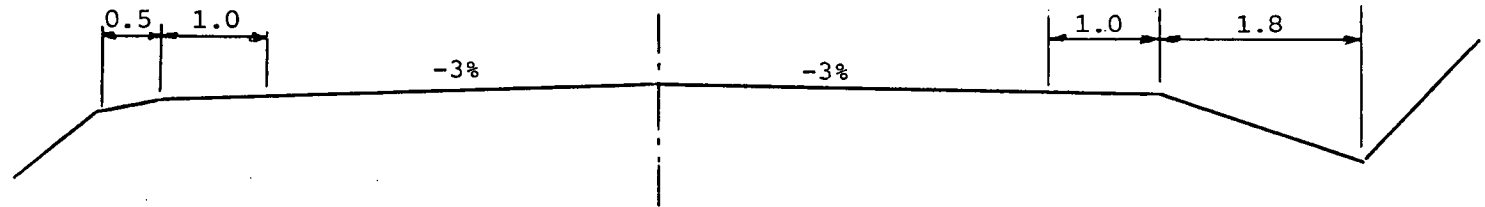ment so as to allow for possible future upgrading (in recognition of the "lumpiness" of road supply, referred to above, page 39).

From an engineering perspective it is apparent that the upgrading of the central section of Jefferys Track to a road quality acceptable to minimum DMR standards would require the corresponding upgrading of most of the associated link roads. The social welfare costs of such an undertaking are detailed in the following section.

COST ESTIMATES

Estimates of costs have been derived from two sources, the federal Bureau of Transport Economics (BTE) and the state Department of Main Roads (DMR). In its "Assessment of the Australian Road System: 1984", the B.T.E. used cost data provided by State Road Authorities to calculate road upgrading costs for roads in rural Australia (Table 2).

The DMR estimates of costs differ from those of the B.T.E. by a factor of up to 10. The reasons for such a large disparity are claimed to be due to the topographical conditions existing in most of Tasmania, where the rugged, hilly, terrain and resistant bed-rock contrasts with the vast areas of relatively flat, sandy, country found in much of outback Australia.

On that assessment the B.T.E.'s overall average for all types of conditions in all types of terrain can be considered inappropriate for the more detailed and specific purpose of estimating the costs of constructing rural roads in Tasmania.

TYPICAL RANGES OF COST PER KILOMETRE FOR

ROAD UPGRADING PROJECTS IN RURAL AREAS, 1981

($ 000)

Final Standard	Original Standard			
Sealed	Unsealed	Sealed One Lane	Sealed Narrow Two Lane	Sealed Wide Two Lane
One Lane	30 - 80	a	a	a
Narrow Two Lane	35 - 85	10 - 60	a	a
Wide Two Lane	40 - 115	20 - 100	10 - 75	a
Three Lane	a	a	85 - 230	80 - 220
Four Lane	a	a	a	200 - 600

a. Indicates that transition is feasible or highly unlikely.

TABLE 2

(Source: Bureau of Transport Economics, 1984, p. 76).

(a) Lachlan Road between New Norfolk and Lachlan
Narrow wooden bridge

(b) Lachlan Road south of Lachlan
Narrow bridge; poor visibility
unmaintained verges

FIGURE 7

It should be pointed out that no two roads are the same and the particular local conditions of any individual road will always cause variations, often of very substantial proportions, from long-term cost averages. Thus it is futile to attempt to estimate an exact ex ante cost of road construction.

The approach adopted by the DMR is to map the alignment of the road using aerial photographs and field surveys in order to obtain preliminary estimates of the length of the road and the nature of various topographically determined features such as gradients, curvatures, elevation, cuttings and bridges. This is then used to provide a preliminary estimate of costs by multiplying the component parts by appropriate cost parameters derived from past experience. If construction of the road is approved and a monetary allocation made to the project, a more detailed estimate of costs is calculated by breaking-down the major categories of the construction process into items that can be individually costed and then re-aggregated to form the final detailed cost estimate. The actual cost of the project, however, can never be fully known until the work itself is actually completed. The highly detailed cost estimate is subject to the possible cumulative effect of relatively small errors compounded over a large number of separate calculations. For this reason, and given the uncertainty of ex ante estimates of actual costs, senior DMR engineers often regard the more generalized initial "rule of thumb" estimate as being at least as good a guide to the ex post final cost as the more detailed final estimate (personal conversations with DMR officers).

(a)   The hamlet of Lachlan
       Vacant general store; poorly maintained road
       small hill farms in distance

(b)   Lachlan Road south of Lachlan
       Pot-holed surface; unmaintained verges;
       no centre-line

FIGURE 8

In presenting a preliminary estimate, the total costs of a rural road project in Tasmania are, for convenience, broken down into road construction costs, bridge construction costs, and maintenance costs. Road construction costs are further sub-divided into costs of drainage, earthworks, pavement, sealing, and remainders (including contingencies and property acquisition), calculated on an average per kilometre basis.

Of these categories the cost of earthworks is the one most susceptible to variations in topography, bedrock, and other construction difficulties and, depending on the particular rural road in question, may vary from as little as $20,000 per km to as much as $150,000 per km. Drainage costs are of the order of $25,000 per km, pavement costs $12,000 per km, sealing costs $20,000 per km, and remainders $60,000 per km (figures obtained from DMR personnel).

These estimates are applied to the separate sections of the complete road link from the Lyell Highway at New Norfolk to the Huon Highway at Grove to give an aggregate cost estimate of the project (Table 3).

The Lachlan Road section (8 km) is assumed to represent essentially an upgrading of the existing alignment, although minor realignments in certain sections are probably inevitable. It is expected that the combined costs of realignment and resealing the road to bring it up to 5.5 metre pavement standard would be of the order of $80,000 per km. A similar estimate is assumed for the sealed section of the Crabtree Road (5 km).

ESTIMATED COSTS: JEFFERYS TRACK UPGRADING

(a) Road Construction

Road Section	Length (km)	Cost Category ($ per km)					Total Cost per km	TOTAL COST
		Drainage	Earthworks	Pavement	Sealing	Remainder		
Lachlan Road	8	-	-	-	20,000	60,000	80,000	640,000
Jefferys Track - Unsealed	6	10,000	50,000	120,000	20,000	60,000	260,000	1,560,000
Jefferys Track - Missing Link	7	25,000	150,000	120,000	20,000	60,000	375,000	2,620,000
Crabtree Road - Unsealed	3	10,000	50,000	120,000	20,000	60,000	260,000	780,000
Crabtree Road - Sealed	5	-	-	-	20,000	60,000	80,000	400,000
						Total Road Construction:		6,000,000

(b) Bridge Construction

6 Bridges x 20 m x 6.5 m x $1,200 per square metre = $936,000 = (say) $1,000,000

(c) Maintenance

(i) Resealing (7 year cycle) = $20,000 per km x 29 = $580,000 = (say) $600,000

(ii) Recurrent maintenance = $1,700 per km per year = $1,700 x 29

= $49,300 = (say) $50,000

TABLE 3

The initial unsealed section of Jefferys Track (6 km) and the unsealed section of Crabtree Road (3 km) both need major reconstruction. It is assumed that reconstruction would take place on their existing alignments thus making drainage and earthworks costs lower than expected with new works. However, pavement and sealing costs are expected to be at their maximum level.

The central "missing link" four-wheel drive section of Jefferys Track needs complete new road construction. Full drainage and earthwork costs are assumed as well as pavement and sealing costs for an alignment essentially the same as the present track.

As shown in Table 3, the total estimated current costs of upgrading Jeffreys Track, including upgrading the sealed road connections via Lachlan and Crabtree to the Lyell and Huon Highways is of the order of $6 million.

Bridge construction costs are estimated on a square metre basis. As with roads, bridges vary substantially in type, span, and method of construction. No bridges are needed for the central section of Jefferys Track but several narrow wooden bridges on the Lachlan Road and Crabtree Road connecting links need replacement (Figure 7). Based on a total of 6 new bridges with a total length of 120 metres, a width of 6.5 metres, and a construction cost of $1,200 per square metre (an estimate considered to be, if anything, on the high side), bridge construction costs for the project are estimated to be $936,000 or, say, $1 million.

Maintenance costs are of two types, continuous repairs and periodic re-sealing. Continuous repairs involve clearing the road verges and repairing surface pot-holes, and are estimated to cost in the order of $2,000 per km per annum. Re-sealing is based on a 7 year cycle at the end of which the complete road surface is primed and sealed at an estimated cost of $20,000 per km.

CONSTRUCTION TIMETABLE

The capital costs of road construction are met by the allocation of funds from public expenditure budgets over a period, usually, of several years. The actual amount of funds allocated in any one year will depend on the state of the economy, the needs of competing projects, and other political considerations. This means that construction takes place in a series of planned stages with the works programme proceeding in accordance with budget allocations.

Most road upgrading is commenced from both ends of the road, where traffic volumes are greatest, and finishes somewhere near the middle. With Jefferys Track, however, it is logical that the central "missing link" section would be built first so as to allow traffic to use the road, before the other sections were attended to. This procedure would enable the government to keep its options open by, if necessary, deferring the upgrading of the associated link roads should the state of the economy or the claims of more pressing projects demand it, whilst at the same time fulfilling its

obligation to open up the road to traffic.

Thus, as with road construction costs, it is not always possible to estimate, ex ante, the actual construction time-table since this is dependent on factors other than the requirements of the road itself. This argument applies particularly to developmental roads where it may be prudent to wait and see how potential beneficiaries respond to the initial improvements before proceeding further with the project.

A final consideration in the construction timetable is the life of the project. Roads, once built, "last a lifetime" if maintained properly. However, it would be as wrong to suggest that benefits represent a stream of values extending indefinitely into the future as it would be to suggest that benefits a few years from now have no value in the present day. Again, developmental roads are different in this regard from "existing demand" roads. The latter, particularly in urban areas, are proposed essentially for the benefits which accrue in a more immediate time span. The highly interactive nature of the transport - land use nexus in urban areas precludes any reliable prediction of what the demand for travel on a particular road may be beyond, say, one or two decades. With developmental roads, however, the whole exercise is designed to cater for potential groups of beneficiaries some of which may take considerable time to evolve and take advantage of the road. In this respect, the Pinnacle Road to the summit of Mt. Wellington, mentioned in the Preface, is a case in point. Built over 50 years ago, the road has only relatively recently realized its full potential as a

major attraction for tourists. No doubt it can be expected to remain so for a further 50 years and possibly more, unlike the "existing demand" roads which may be quickly superseded by alternative transport routes. In order to adopt a conservative approach to the potential benefits arising from an upgraded Jefferys Track it has been decided in this study to adopt a 50 year time horizon, recognizing that benefits are likely to continue to accrue well beyond that period but that their present value may be regarded as negligible or , at best, a bonus.

On the assumption that the central "missing link" section of Jefferys Track would be constructed first, and on the adoption of a 50 year life span for the project, the estimated stream of incurred expenditures for the upgrading proposal is shown in Figure 9.

Again it must be emphasized that, even in the project were approved the timetable for the allocation of funds is impossible to estimate, given present budgetary practices and the exogenous nature of the factors which would determine the project's priorities. In particular the upgrading of the sealed sections of Lachlan Road and Crabtree Road or parts of them could be deferred for many years.

MARGINAL TIME PREFERENCE RATE

The fact that costs are incurred, and benefits accrue, over a number of years means that they need to be translated into present monetary values in order to be compared. The usual method used to

COST STREAMS

Assumptions: Construction Period: 8 years

$1.5 m in each of first two years
$1.0 m in each of years 3 and 4
$0.5 m in each of years 5 to 8

Maintenance:

$0.6 m resealing costs each 7 years

%50,000 recurrent maintenance in all other years

Time Span: 50 years

$1,500,000

$1,000,000

$500,00

$600,000

$500,000

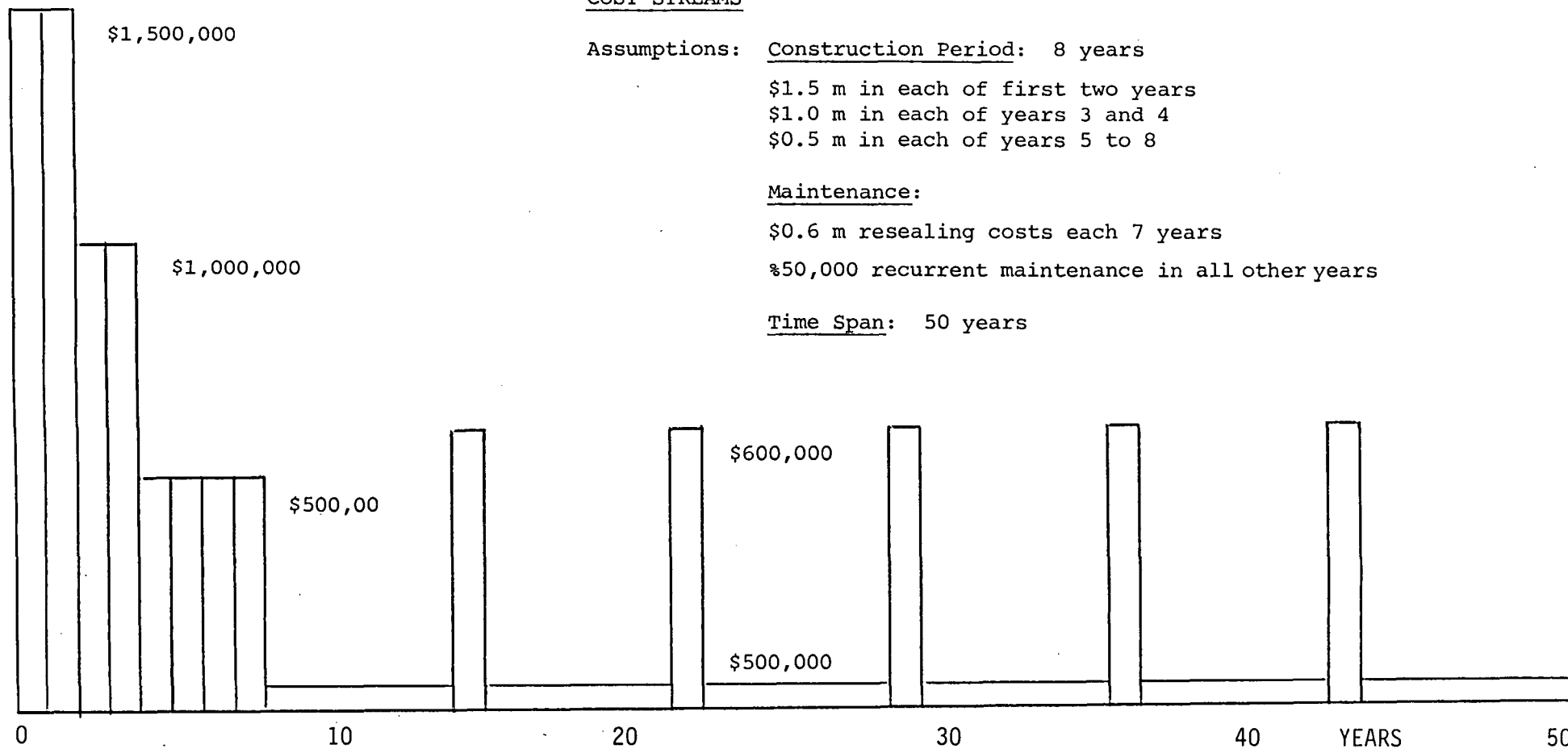| 0 | 10 | 20 | 30 | 40 | YEARS | 50 |

FIGURE 9

do this in cost-benefit analysis is to discount future costs and

benefits back to the present by means of the social marginal time

preference rate, or social MTPR (Sugden and Williams, pp. 215-226).

The marginal time preference rate recognizes that consumption in

one time period is a different good from consumption in another

(Sugden and Williams, p. 13). More specifically an individual

would need to receive compensation in the form of extra units of

a good if he were asked to defer its consumption from the present

until some time in the future. If he is indifferent as between

the consumption of an extra 1 unit of consumption now and $1 + r$

extra units of consumption in period 1, then his private MTPR is

defined as r. In cost-benefit analysis the social MTPR is assumed

to be an aggregate of all the individual private MTPRs. The

methodological problems of making this private individual-to-

social collective step need not concern us here since they are

no different from the other methodological problems of trans-

lating from the individual to the collective level described in

Chapter 3. What is important, however, is that the social MTPR

represents the real costs of forgoing extra consumption in the

presentand is conceptually distinct from any apparent effect

caused by general price changes (inflation). Across-the-board

general price changes affect all costs and benefits equally and

have no net economic effect. In practice, however, rates of

inflation, as well as taxation and other market imperfections,

do create problems in trying to measure the actual value of the

social MTPR. This is because the MTPR is linked to market

interest rates, and since the latter are expressed in nominal

terms they reflect market expectations and uncertainties as to future rates of inflation as well as deferred consumption.

A high MTPR implies a high valuation on present consumption whereas a low MTPR is indicative of a desire to forego current consumption for the benefit of future generations.

In project evaluations, the sensitivity of the analysis to different values of the social MTPR is obviously related to the time horizon of the project. For example, a $10,000 benefit accruing in 20 years time has a present value of $5,537 at a MTPR of 3%, a value of $3,118 at a MTPR of 6%, and of $1,486 at a MTPR of 10%, whereas a $24,274 benefit accruing in 50 years time has the same present value of $5,537 at a 3% MTPR, but a value of only $1,318 at the 6% MTPR and a mere $206 at the 10% MTPR.

Given that market interest rates incorporate a premium for the uncertainties of future inflationary effects and given also that the social MTPR is expected to be lower than private MTPRs (on the argument that people tend to act against their own interests by spending now rather than saving for later; Sugden and Williams, p. 219), it may be argued that the real social MTPR is less than the difference between nominal market interest rates and the inflation rate. At present that difference is approximately 8%, based on a nominal market interest rate of 15% and an inflation rate of 7%. It would seem appropriate therefore to expect the real social MTPR to be somewhere betwen 3% and 6%. However as a conservative backstop, and to provide a check on the sensitivity of the analysis to the social MTPR adopted, a high rate of 10% will also be used.

Based on the estimated cost stream shown in Figure   9 , the
present value of the costs of upgrading Jefferys Track is calculated
as $8,5000,000   for a social MTPR of 3%, and

   $6,8000,000   for a social MTPR of 6%, or

   $5,6000,000   for a social MTPR of 10%.

A NOTE ON THE NET SOCIAL COST OF LABOUR

A relatively large proportion of the costs or road construction
is paid as wage rates to labour. Table 4 shows the relative weight
of various items included in the road construction, road maintenance,
and bridge expenditure categories of DMR road expenditures. Those
shown with an asterisk represent payments to labour and in total
these comprise some 67.5% of total expenditure. In addition, parts
of the expenditures on other items contain labour components.
Although most of this payment is to workers who are already employed,
perhaps as much as 10% is paid to workers who would otherwise be
unemployed. In a perfectly competitive labour market the price of
labour measures the value of its marginal product. Therefore, the
employment of already-employed workers represents no net welfare
gain. However, in situations of involuntary unemployment where,
for example, award rates are set at levels above the free market
equilibrium price of labour, the real social cost of employing an
additional unit of labour is measured not by the wage rate but by
the amount at which the worker would just be willing to forego his
leisure to take up employment (Sugden and Williams, p. 104). Since
this "shadow price" of labour is not revealed and given that funds
allocated to the road project have an opportunity cost represented

AVERAGE ROAD CONSTRUCTION ITEMS

<u>Percentage Weight</u>

<u>Road Construction</u>	62

Direct Expenditure:

* Wages	10.0
Materials	10.5
* Departmental Plant Operating Costs	14.0
* Private Plant Hire	11.0
Property Acquisition	2.0
Sundries	2.5

Overheads

* Engineering branch salaries	7.5
Miscellaneous expenditure	2.5
* Miscellaneous salaries	2.0

<u>Road Maintenance</u>	22

Direct Expenditure:

* Wages	11.0
Materials	2.5
* Departmental Plant Operating Costs	3.0
* Private Plant Hire	3.0

Overheads

* Engineering branch salaries	1.0
Miscellaneous expenditure	1.0
* Miscellaneous salaries	0.5

<u>Bridge Expenditure</u>	16

Direct Expenditure

* Wages	5.0
Materials	4.0
* Departmental Plant Operating Costs	1.0
* Private Plant Hire	1.0
Sundries	2.0

Overheads

* Engineering branch salaries	2.0
* Miscellaneous expenditure	0.5
* Miscellaneous salaries	0.5

TOTAL   100

* Complete or high labour component.

TABLE 4

(Source: Department of Main Roads)

by the marginal project foregone, the approach taken here is the

conventional one of regarding DMR payments as being true resource

costs (see also Woolston, p.21).

CHAPTER 5   JEFFERYS TRACK UPGRADING: POTENTIAL BENEFITS

BENEFIT THRESHOLD LIMITS

It was shown in the previous chapter that the estimated cost

of upgrading Jefferys Track, including its link roads to the Lyell

and Huon Highways, is expected, based on a 50 year life span, to be:

$8,500,000 in present money terms at a 3% social MTPR,

$6,800,000 in present money terms at a 6% social MTPR, or

$5,600,000 in present money terms at a 10% social MTPR.

To obtain an approximate estimate as to whether or not such

an expenditure is warranted, it is worth considering the level at

which a constant stream of benefits would need to reach in order

to just cover the total cost.

The value of such an annual stream can be calculated from

standard discount tables (for example, DeGarmo, *et al*, Appendix E,

pp. 531-551), and works out, over a 50 year period, at:

$340,000 in present money terms at a 3% social MTPR,

$440,000 in present money terms at a 6% social MTPR, or

$570,000 in present money terms at a 10% social MTPR.

These money terms can be translated into road user benefits

and hence into a threshold volume of traffic that would have to be

generated by the new road to warrant its construction.

The Bureau of Transport Economics identifies travel time and reductions

in vehicle operating costs as the major items of benefits accruing to

road users from road improvement projects. The study estimates that

reduced travel time accounts for 39% and reduced vehicle operating

costs 58% of total benefits, the remainder accruing to other effects

including reduced accident costs (B.T.E., 1984, p.79).

The same study, although noting that the value to be placed on travel time savings is particularly difficult to establish, (especially for studies of a very general nature) calculated a value of time by type of vehicle of:

Cars	$6.78 per hour
Light Commercials	$7.28 per hour
Trucks	$6.60 per hour

(B.T.E., 1984, p.79).

Given the similar values for the three types of vehicles and the generality of the studies on which they are based, it would seem prudent to avoid problems relating to the mix of vehicles in traffic flows and adopt a value for travel time savings of $6.80 per hour for all types of vehicles.

Figures 10 and 11 show the travel time networks for the situation as it exists at the present time (Figure 10) and the situation as it would exist if Jefferys Track were to be upgraded (Figure 11). Travel times are based on actual driving experience under normal road conditions and assume a Lachlan to Crabtree travel time of 30 minutes if the link were to be established.

Table 5 shows the travel times between each pair of settlements in the network and is derived from Figures 10 and 11. A comparison between the upper north-east half of the matrix and the lower south-west half compares the travel times if the Jefferys Track link were established (the north-east) with existing travel times (the south-west).

Table 6 lists the six settlement pairs which would experience travel time savings if Jefferys Track were to be upgraded.

Not surprisingly, the Lachlan Crabtree link experiences a considerable saving, from a current 81 minutes to an expected 30

TRAVEL TIME MATRIX

(WITH AND WITHOUT JEFFERYS TRACK LINK)

From \ To	Lach.	NN	Gran.	Hob.	King.	Lon.	Grove	Crab.
Lachlan	*	8	20	38	49	52	37	30
New Norfolk	8	*	12	30	41	51	45	38
Granton	20	12	*	18	29	39	54	50
Hobart	38	30	18	*	11	21	36	43
Kingston	49	41	29	11	*	10	25	32
Longley	59	51	39	21	10	*	15	22
Grove	74	66	54	36	25	15	*	7
Crabtree	81	73	61	43	32	22	7	*

Figures in the lower south-west half of the matrix
represent existing travel times between centres

Figures in the upper north-east half of the matrix
represent travel times with Jefferys Track link
completed

Travel time improvements occur in the six cells in
the extreme right-hand upper corner

TABLE 5

minutes, and similar, but lesser, savings accrue to trips between each of these settlements and their adjacent settlements in the adjourning valley.

Of major importance is the travel time saving between New Norfolk and Grove of some 21 minutes. New Norfolk and Grove are at the junctions of the Jefferys Track link roads and the Lyell and Huon Highways respectively. Therefore the travel time saving of 21 minutes applies to all trips linking areas west of New Norfolk with areas south of Grove. At a value of travel time of $6.80 per hour, this 21 minute saving is worth $2.38.

The connection of New Norfolk with Grove via Jefferys Track also saves 41 km in distance (29 km compared with 70 km via Hobart, see above, p.1), and therefore considerable savings in vehicle operating costs as well as travel time.

Vehicle operating costs, despite a number of complex relation-ships used to calculate them, are just as difficult to estimate as values of travel time. The use of Jefferys Track compared with the Lyell and Huon Highways may save fuel and wear-and-tear costs of the order of 10 cents per km but may also, because of its steep and wind-ing route, incur additional costs caused by frequent braking and changing of gears.

A value of vehicle operating cost savings of 8 cents per km is thought to be a reasonable and conservative value to adopt in this study and represents a saving of $3.28 for the 41 km reduction in distance between New Norfolk and Grove achieved by using Jefferys Track.

For those motorists who already travel between New Norfolk and Grove (and beyond) the opportunity to use Jefferys Track represents a saving, on the assumptions used, of $2.38 in travel

TRAVEL TIME IMPROVEMENTS (FROM TABLE 5)

Travel Time (Minutes)

Link	Without Jefferys Track	With Jefferys Track	Saving
Lachlan - Longley	59	52	7
Lachlan - Grove	74	37	37
Lachlan - Crabtree	81	30	51
Crabtree - New Norfolk	73	38	35
Crabtree - Granton	61	50	11
New Norfolk-Grove	66	45	21

TABLE 6

time and $3.28 in vehicle operating costs, a total saving of $5.66. As a check on the validity of these estimates, the ratio of travel time savings to savings in vehicle operating costs is 42:58, a ratio almost identical to the B.T.E. estimate given above.

However, not all road users travelling between New Norfolk and Grove (and beyond), if Jefferys Track were to be upgraded, would benefit to this amount. The opening of the route would generate travel from those who, at the present costs, choose not to do so. These generated road users presumably include those at the margin of making the trip at present costs and who would therefore benefit almost to the full amount, as well as those who would need to receive almost the full cost savings before being persuaded to travel.

In common with other transport studies it is assumed that there is a linear demand function for the range of traffic considered, so that a value of half the total benefit, namely $2.83, can be taken as the average benefit for generated traffic.

As a preliminary estimate of the threshold level of traffic required to justify the upgrading of Jefferys Track, it is proposed to use for calculation purposes only the generated component of traffic. Thus for the time being, the benefits accruing to existing road users and the further secondary effects likely to flow from the project will be ignored.
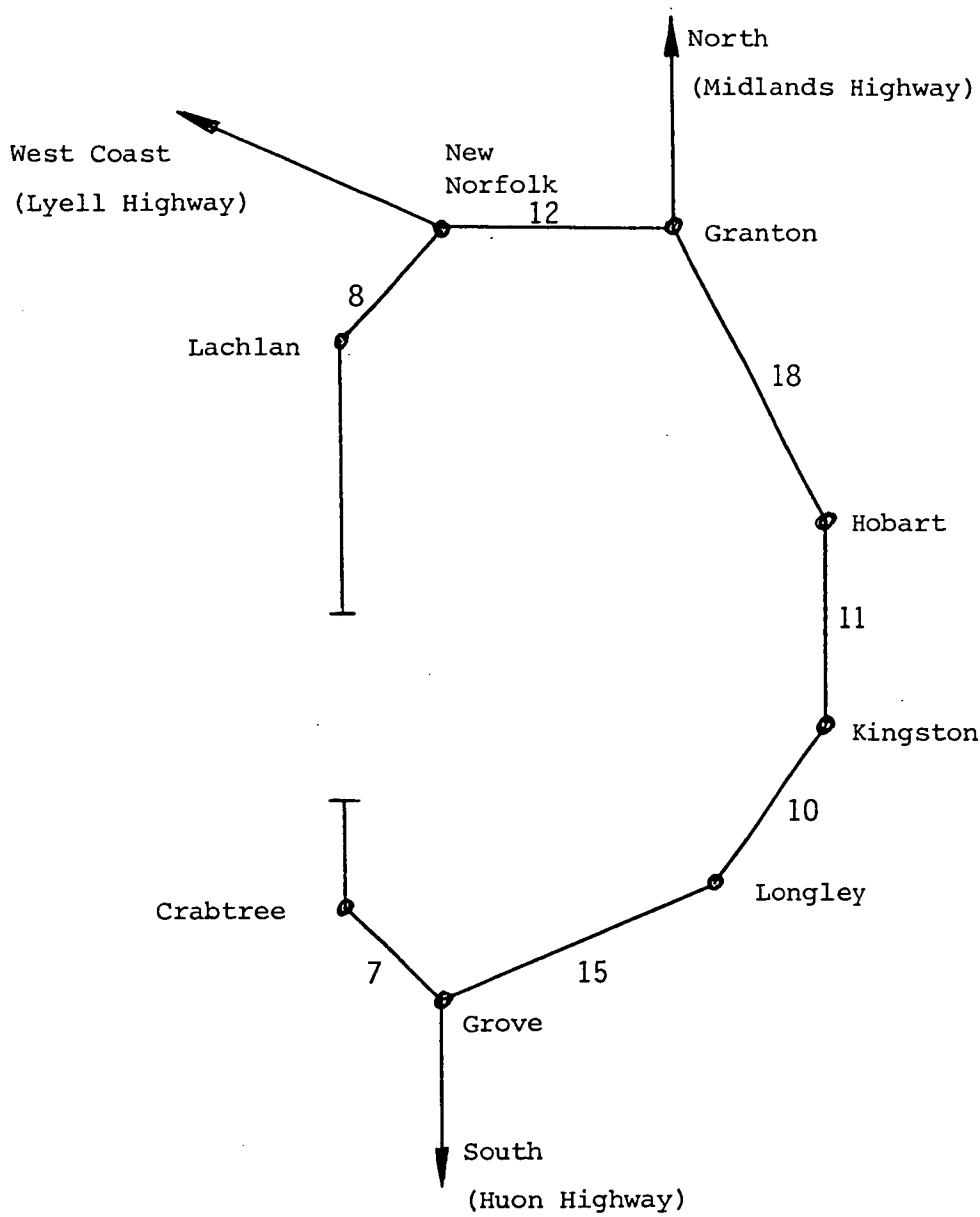
In order to reach the annual benefit threshold limit of $340,000, $440,000 or $570,000 respectively, according to the social MTPR adopted, the number of trips needed to be generated at an average benefit of $2.83 per trip is given by:

120,100 at an assumed social MTPR of 3%,

155,500 at an assumed social MTPR of 6%, or

201,400 at an assumed social MTPR of 10%.

North

(Midlands Highway)

West Coast
(Lyell Highway)

New
Norfolk
12

Granton

8

Lachlan

18

Hobart

11

Kingston

10

Longley

Crabtree

7

15

Grove

South
(Huon Highway)

Figures indicate travel time in minutes between
pairs of adjacent centres.

FIGURE 10

These volumes are equivalent to an annual average daily traffic (AADT) of:

330 at an assumed social MTPR of 3%,

430 at an assumed social MTPR of 6%, or

550 at an assumed social MTPR of 10%.

According to DMR traffic engineers AADT volumes of the order of 500 vehicles are typical of rural roads such as the Colebrook Main Road, the Esk Main Road, the Lyell Highway at Tarreleah, the Channel Highway at Gordon, and similar roads on the North-West and North-East Coasts.

The proposed upgrading of Jefferys Track would create a rural link road of comparable standard to those mentioned and on the threshold level of generated traffic calculated above would seem to be clearly warranted on a cost-benefit basis.

It must be remembered however, that the threshold volumes of traffic are based on an assumed constant stream of benefits over the life of the project (50 years). Obviously, generated traffic takes a long period of time to build up and therefore the benefits of higher volumes of traffic in later years, given their relatively low present values, are not likely to fully compensate for lower volumes in the early years. This is particularly so if a high value of the social MTPR is adopted.

Nevertheless, when the benefits to existing road users and the potentially very considerable secondary effects are taken into account, and when the benefits accruing beyond the 50 year time span are also considered, it would seem that any underestimation of the threshold level of benefit would be more than outweighed by these additional benefits.
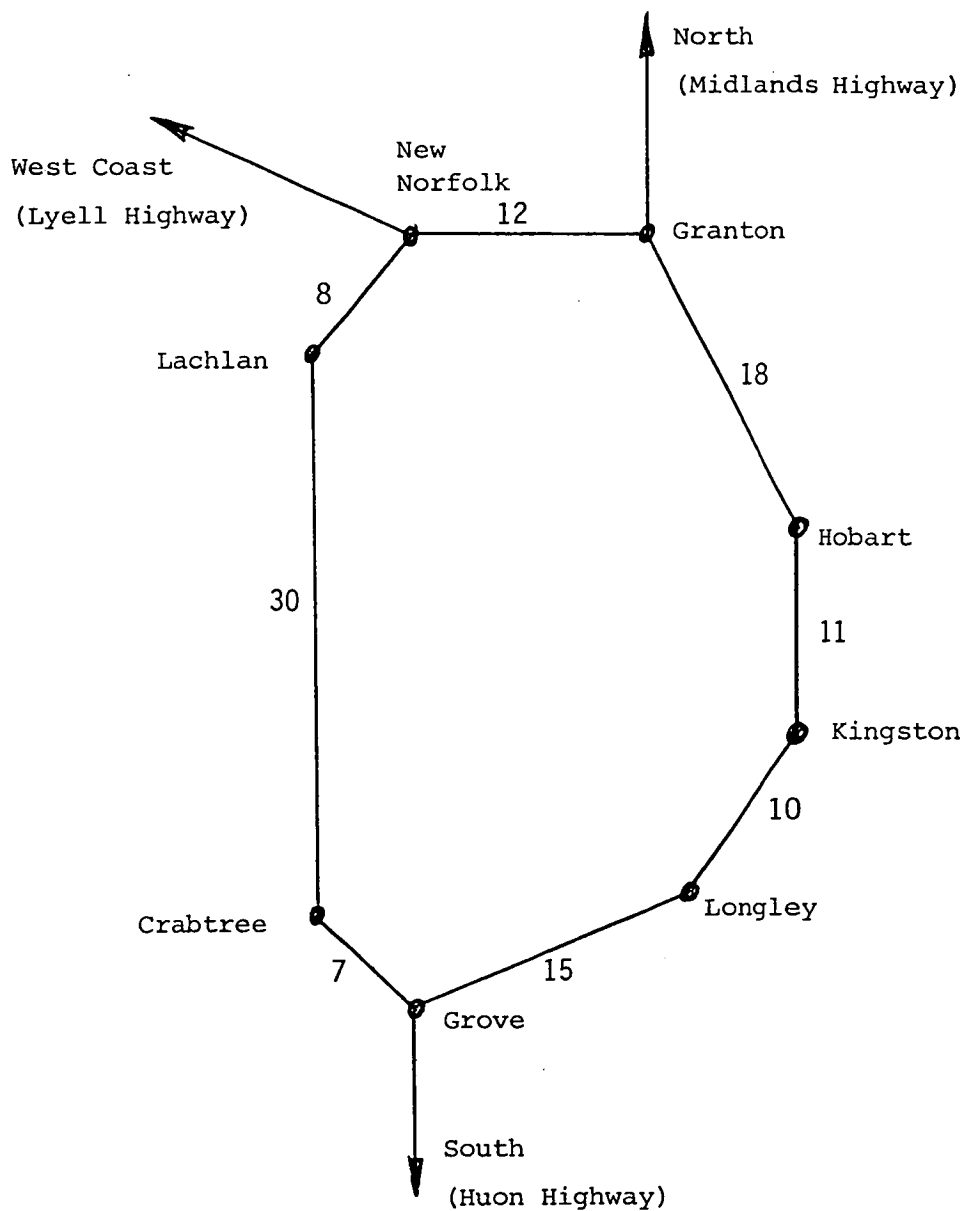
Figures indicate travel time in minutes between pairs of adjacent centres.

FIGURE 11

ADDITIONAL BENEFITS

The increased accessibility of the Lachlan and Crabtree Rivulet valleys as a result of the Jefferys Track upgrading is likely to lead to greater economic activity in the two valleys as various individuals and firms readjust their locations and travel patterns to take advantage of travel time savings. The external and secondary effects of increased accessibility described in Chapter 3 can be expected to unfold over time and so alter land use patterns and travel demands.

A full statistical analysis of the complex external and secondary effects that may eventuate is plagued by uncertainty and lack of adequate modelling procedures. Certainly the lower Derwent and Huon Valleys are similar to each other in economic and social composition and while this may not generate much economic interaction between them it may stimulate greater social contact. Interaction flows are generally modelled by techniques such as the gravity model which attributes travel between places as a function of the product of their population sizes, impeded by their spatial separation.

Benefits to firms, including logging contractors and farmers, accrue as full time and operating cost savings to those already travelling between the two major centres in the respective valleys and, on average, half savings for new generated traffic.

Undoubtedly the major potential beneficiary group are likely to be tourists from interstate and other parts of Tasmania, and day-trippers from the Hobart area. To these groups the establishment of a circuit in the road network between the Derwent and Huon Valleys is likely to create opportunities for a wide range

of discretionary recreational trips. Multiplier effects from the expenditures of tourists and day-trippers are likely to be an important secondary benefit to some of the isolated rural communities at present undergoing economic stagnation (see the photograph of Lachlan hamlet, Figure 8).

The lack of an adequate general theory of transportation and land use interaction precludes an accurate estimation of the full secondary effects deriving from developmental road investment. However, given that the volume of generated traffic required to reach the benefit threshold level is moderately low compared with existing traffic volumes on other comparable rural roads, the secondary benefits flowing from an upgrading of Jefferys Track are likely to be an additional bonus to these direct benefits.

CHAPTER 6   SUMMARY AND CONCLUSIONS

EVALUATION OF JEFFERYS TRACK PROPOSAL

The costs of a proposal to upgrade Jefferys Track are examined in Chapter 4. There it is recognized that any decision to upgrade the central 7 km "missing link" section of the road carries with it an implied obligation to upgrade its associated link roads.

The costs of carrying-out these works are detailed in Table 3 and following discussion on the vagaries of construction timetables a possible stream of costs extending over a 50 year time span for the project is shown as Figure 9.

Based on these estimates and assumptions the present value of the project is given for three different social marginal time preference rates (3%, 6% and 10%) and is calculated to be:

$8,500,000 at a social MTPR of 3%,

$6,800,000 at a social MTPR of 6%, or

$5,600,000 at a social MTPR of 10%.

The benefits accruing from the proposed upgraded Jefferys Track represent, in the first instance, travel time savings and savings in vehicle operating costs to road users.

Based on generated traffic alone, it was shown that an equivalent annual constant stream of benefits necessary to just cover the costs of the project would require annual average daily traffic (AADT) volumes of:

330 vehicles at a social MTPR of 3%,

430 vehicles at a social MTPR of 6%, or

550 vehicles at a social MTPR of 10%.

The AADTs are well within the traffic volumes of other rural

roads in Tasmania of similar standard to the proposed reconstructed

Jefferys Track even at the conservatively high social MTPR of 10%.

On this basis the additional benefits to existing road users

and the secondary effects generated by the project, although not

specifically calculated are a bonus, and justify the conclusion

that the upgrading of Jefferys Track as a developmental road and as

part of Tasmania's road infrastructure is warranted on social

welfare grounds.

CONCLUSIONS

The traditional application of cost-benefit analysis to road

projects is in the evaluation of "existing demand" roads. In such

studies, benefits accruing to direct existing road users in the form

of travel time and vehicle operating cost savings are summed and

compared with the estimated cost of the project.

Many of the methodological problems in the application of cost-

benefit analysis and the potentially important external and secondary

effects of road improvement schemes are either ignored or glossed-

over in such studies.

The application of cost-benefit analysis to developmental

roads, where existing traffic volumes are low or non-existent,

emphasises these methodological and practical problems.

A major consideration is the choice of the social MTPR and

the associated life of the project. In traditional cost-benefit

applications to "existing demand" roads a large proportion of the

benefits accrue early in the life of the project and are therefore

relatively insensitive to possible variations in the MTPR.

With developmental roads, however, many of the effects unfold over a long period of time as the land use pattern and people's travel behaviour adjusts to the changed patterns of accessibility.

Long life-spans for projects may be necessary to capture the benefits which flow from the road improvement. Similarly it is unrealistic to adopt a high social MTPR for roads where the life-time may be very large and where considerable benefits continue to accrue. Society's views on intertemporal and intergenerational transactions are such as to suggest the adoption of a low MTPR.

On the cost side of the analysis the two major problems are the inability to estimate costs accurately and the variations in construction timetables. Costs of developmental roads vary by a factor of as much as 10 depending on the terrain and various unanticipated features.

Variations in the construction timetables may have a large bearing on the viability of the project and the calculated present value of its costs. Decisions in regard to the construction timetable are usually beyond the control or the anticipation of the analyst.

On the benefit side the main problems are attempting to set an appropriate value for travel time savings and, especially in regard to developmental roads, the interaction effects between the transport system and the land use pattern. The enormity of the problem of trying to trace the secondary and multiplier effects of changes in the transport system to changes in the land use system as a result of altered accessibility levels, encourages cost-benefit analysts to adopt a pragmatic approach and largely ignore their effects.

The above issues are common to all cost-benefit appraisals. However they are particularly evident in any attempt to apply cost-benefit analysis to developmental road proposals.

The variations in estimates which make cost-benefit analyses of doubtful accuracy are general beyond the control of the analyst either because of genuine problems in the *ex ante* estimate of costs, construction programmes, and social marginal time preference rates, or because of a lack of theoretical understanding of the full impacts of the transportation land-use interaction that renders *ex ante* estimations of benefits equally questionable.

In the end it may be that the best decision making process is to leave the matter of developmental roads to the judgment of politicians anxious to re-create their own boyhood voyages of discovery.

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