Submission
No 78

INQUIRY INTO PACIFIC HIGHWAY UPGRADES

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Subject:

Summary

SUBMISSION TO THE PARLIAMENTARY INQUIRY ON THE WOODBURN TO BALLINA UPGRADE OF THE PACIFIC HIGHWAY

BLACKWALL HIGHWAY ACTION GROUP

AUGUST 2005

1.0 INTRODUCTION

This document is a formal submission to the Parliamentary Inquiry made by the Blackwall Highway Action Group. The group welcomes the opportunity to address the Parliamentary Committee and deliver a multimedia presentation on the key issues contained within this submission.

Relevant experts have prepared each of the chapters contained within this submission, and extensive supporting documentation is available for provision to the Parliamentary Inquiry, should it be required.

Independent field assessments of Flora and Fauna and geotechnical conditions upon private lands along Option 2C of the Woodburn to Ballina Upgrade are still underway and it is likely that substantial additional results will be gathered prior to addressing the Parliamentary Inquiry. Maps and other details of information collected after delivery of this submission will be presented to the Inquiry upon completion.

2.0 FLORA AND FAUNA ASSESSMENT

SUMMARY REVIEW OF FLORA AND FAUNA ASSESSMENT OF ROUTE OPTIONS WOODBURN TO BALLINA PACIFIC HIGHWAY UPGRADE

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August 2005

2.1 INTRODUCTION

A review of the Flora and Fauna Assessment (Geolyse Consultants, 2005) for the Woodburn to Ballina Pacific Highway Upgrade has identified a large number of errors, omissions and flaws in the assessment. The flaws and omissions within project assessment methodologies, documentation and conclusions are of such magnitude that the report can not be used as a reliable depiction of ecological significance of the study area or the likelihood of significant impact, and hence decisions can not be made on this flawed basis. **AS A RESULT A COMPLETE RE-ASSESSMENT OF THE STUDY AREA AND ROUTE OPTIONS IS REQUIRED BEFORE DECISIONS CAN BE MADE IN RELATION TO ROUTE OPTIONS OR LIKELIHOOD OF SIGNIFICANT IMPACT.**

Of fundamental concern is the fact that **THE ASSESSMENT HAS FAILED TO MEET ITS OWN STATED OBJECTIVES** (as detailed on page 3 of the report), particularly to "*avoid impacts on ecological systems through the planning process*".

2.2 PROVISION OF INFORMATION TO ECOLOGY FOCUS GROUP MEMBERS

These concerns could have been addressed far earlier had project documentation been provided to members of the Ecology Focus Group far earlier. The report clearly states that a draft of the report was finished on 30 May 2005, yet copies of the assessment were not provided to focus group members until more than 2 weeks later.

2.3 PERSONALLY SUPPLIED RECORDS NOT USED

Records of threatened taxa were provided by myself to the RTA, Hyder and Geolyse Consultants in February and March, yet have not been considered in the assessment. These records were of point localities of a high level of accuracy (<20m). The records are included, seemingly as an afterthought, in the appendices. These records are the most reliable available within the study area and demonstrate that a number of Route Options (particularly 2A-2C) pass through the KNOWN HABITAT for a large number of threatened species, a fact that has not been addressed or documented within the project report.

2.4 INDEPENDENT FIELD ASSESSMENTS LOCATED NUMEROUS ADDITIONAL THREATENED TAXA IN STUDY SITES USED FOR THE ASSESSMENT

A series of independent field assessments have been undertaken at nominated surveys sites contained within the report. A large number (14) of additional threatened taxa (detailed below) have been located during these assessments and the reliability of the field survey results presented within the report is highly questionable and numerous additional records of threatened taxa have been made. The botanical and zoological skills or thoroughness of the field survey team must be questioned on this basis.

2.4.1 Flora

Green –leaved Rose Walnut *Endiandra muelleri* ssp. *bracteata*

An individual of this Endangered (Schedule 1) species was located along the pathway of Options 2A-2C and within a Geolyse Study site. The botanical skills or thoroughness of the field survey team must be questioned on this basis.

Swamp Orchid, *Phaius australis*

Two populations of this Endangered (Schedule 1) orchid have been located along Route 2C – one of approximately thirty plants and a second population of two plants. Due to the extreme rarity of this species and the risk of theft, records of this species have been made available confidentially to the Department of Environment and Conservation.

White Laceflower *Archidendron hendersonii*

My personally submitted record of this species at its southernmost recorded locality has been ignored and the assessment has failed to consider the species. A large (ca. 20m) specimen of this Vulnerable species was located along the path of options 2A-2C and within a Geolyse Study site. Another individual of the species was located at the far north of Options 2A-2C, whilst the individual mapped by myself has not been located by the project team. The botanical skills or thoroughness of the field survey team must be questioned on this basis.

Red Lilly Pilly *Syzygium hodgkinsoniae*

An individual of this Vulnerable (Schedule 2) species was located along the pathway of Options 2A-2C and within a Geolyse Study site. This is the southernmost recorded locality for this species. The botanical skills or thoroughness of the field survey team must be questioned on this basis.

Palm Orchid, *Oberonia titania* (syn. *palmicola*)

A large number of individuals of this Vulnerable species were located along the Routes of Options 2A-2C. The botanical skills or thoroughness of the field survey team must be questioned on this basis.

The populations located along route 2C are the largest in NSW containing over 500 individuals of a species that is otherwise known in very small numbers within an area (generally < 20 individuals).

Rough Leaved Bush Nut *Macadamia tetraphylla*

Seven individuals of this Vulnerable species were located at the southern most recorded occurrence for the species along the alignment of Route Options 2A-2C. The botanical skills or thoroughness of the field survey team must be questioned on this basis.

These populations are of global significance (Kim Jones, Research and Development Manager, Australian Macadamia Society *pers. comm.*) as they are the southernmost naturally occurring Macadamias in the world. These populations are of immense value to the global Macadamia industry.

2.4.2 Fauna

Albert's Lyrebird *Menura alberti*

The only record of this Vulnerable (TSC and EPBC Act) species ever made in Coastal Swamp Forest was made at a study site in the middle of Options 2A-2C. Furthermore this isolated southernmost population has been nominated as an Endangered Population under the TSC Act. This species has not been considered at all in the assessment.

Red Legged Pademelon *Thylogale stigmatica*

An individual of this Vulnerable species was recorded within a study site along the path of Options 2A-2C; this is indicative of the presence of a larger population in the area from Coolgardie – Lumleys Lane – Buckombil Mountain (personal records show a broader distribution).

Koala *Phascolarctos cinereus*

Independent surveys at most of the Geolyse Consultants' Study sites throughout Section 2 have shown the presence of substantial breeding populations of Koalas The field surveys undertaken by Geolyse Consultants lack rigour; as the presence of Koalas was immediately obvious from the presence of individuals (with young) as well as characteristic scats and scratches. The zoological skills or thoroughness of the field survey team must be questioned on this basis.

Every parcel of forested vegetation along route 2C has large breeding populations of Koala present. There are at least several hundred animals within the area encircled by Old Bagotville Rd – Lumleys Lane with further large populations to the south of Old Bagotville Rd and the south of Coolgardie Rd. Even larger populations occur to the west of Route 2C with numerous documented movements within and between populations in the area.

Long Nosed Potoroo *Potorous tridactylus*

Two individuals of the nationally Vulnerable Long Nosed Potoroo were located along Route 2C in the north of the study area (Lumleys Lane) with an additional individual located just east of Route 2C to the east of Old Bagotville Rd. Signs of foraging of this species were located to the south of Old Bagotville Rd along Option 2C. Available evidence suggests that the largest Long Nosed Potoroo population on the Lower Richmond Floodplain occurs along the alignment of option 2C.

Grey Crowned Babbler, *Pomatostomus temporalis*

Three nesting populations of the Grey Crowned Babbler were located along Options 2C during field assessments. These populations are the easternmost of the entire species and are the largest populations occurring on the Lower Richmond Floodplain. This species will become locally extinct in the area following construction of a six lane freeway through core breeding and foraging territory.

Ground Parrot, *Pezoporus wallicus*

The Ground Parrot is a very rare and nationally threatened species only known from Wet Heath and Sedgeland complexes. A record of a single Ground Parrot was made at the eastern edge of Option 2C to the north of Old Bagotville Rd. The species has been recorded previously to the south of Lumleys Lane (within Options 2C) and to the west of the Airfield on the northern side of Wardell.

Bush Hen *Amaurornis olivaceus*

The Bush Hen has been recorded at several sites along the middle sections of Option 2C in the areas from Thurgates Lane – Lumleys Lane. The largest breeding populations of this species occur in the Lower Richmond, and some of the largest populations in NSW occur in this area.

Grass Owl *Tyto capensis*

Populations of the Grass Owl along Option 2C were located to the south of Old Bagotville Rd, between Old Bagotville Rd and Thurgates Lane and between Wardell Rd and Lumleys lane. This area contains the highest densities of this threatened species in NSW (Maciejewski, 1994).

Mangrove Honeyeater, *Lichenostomus fasciogularis*

A pair of Vulnerable Mangrove Honeyeaters was recorded foraging in River Mangrove (*Aegiceras corniculatum*) at Laws Point on the northern bank of the Richmond River within the footprint of Route 2C. It appears as though there may be nesting activity in this area, although a nest is yet to be located.

Squirrel Glider *Petaurus norfolcensis*

Large populations of Squirrel Glider were located in all forested areas along Route 2C. High density populations were located between Thurgates Lane and Old Bagotville Rd and between Wardell Rd and Lumleys Lane.

Squirrel Gliders were recorded moving between the forests of the Blackwall Range and the coastal floodplain forests, an area through which option 2C is proposed.

Eastern Chestnut Mouse *Pseudomys gracilicaudatus*

Substantial populations of this species were recorded in recently burnt heath (approximately 3 years previously) to the south of Thurgates Lane along Route 2C. These are the only known populations in the Lower Richmond Valley and are of immense significance in the State of NSW.

Grey-headed Flying-fox *Pteropus poliocephalus*

All forested areas within Route 2C are recognised as key winter habitat areas for the Grey-headed Flying-fox (National GHFF Recovery Team *pers comm.*). The greatest threat to the survival of this species is loss of key winter habitat areas, with the scale of vegetation removal required for Option 2C, major impacts upon this nationally Vulnerable species will occur.

Wallum Sedge Frog *Litoria olongburensis*

The largest populations of this nationally Vulnerable species in the Lower Richmond Valley occur to the west of Wardell. Major populations of this species are known from Heath areas along 2C to the south of Old Bagotville Rd, between Thurgates Land and Old Bagotville Rd and between Wardell Road and Lumleys Lane. The construction of a six lane highway through undisturbed habitats and large intact populations of this species will result in local extinctions of nationally significant populations.

Wallum Froglet *Crinia tinnula*

The Wallum Froglet was recorded in large populations along most of the wetland and heathland sections along Route 2C. Populations of hundreds of individuals were recorded south of Old Bagotville Rd, between Thurgates Lane and Old Bagotville Rd and between Wardell Rd and Lumleys Lane. These are the largest populations of the species in the Lower Richmond Valley. Furthermore these populations are of such a great size that they are of state significance.

Oxleyan Pygmy Perch *Nannoperca oxleyana*

The nationally endangered Oxleyan Pygmy Perch was recorded between Wardell Rd and Lumleys Lane along a series of drainage lines passing through the northern sections of Route 2C. This is the northern most population of this critically endangered fish in NSW and is a significant newly located population. The size of this population is yet to be adequately assessed. The construction of a six lane highway through breeding habitat will endanger a nationally significant population of the species. Of particular concern is the disturbance to drainage patterns and groundwater dynamics with construction of the road, this is recognised as a key threat to the breeding dynamics of the species (NSW DPI, 2004).

2.5 SPECIFIC AREAS OF CONCERN

The following list details areas of major concern with the assessment, an accompanying review details many of the concerns in far greater detail:

2.5.1 Lack of appropriateness and adequacy of survey, inconsistency with DEC Survey guidelines

Despite repeated public assertions that surveys were undertaken in accordance with DEC guidelines for flora and fauna survey, the assessment has failed to address the requirements of DEC survey guidelines (as follows):

a) Inappropriate Vegetation Community Mapping techniques

The use of PATN analysis for the delineation of vegetation communities within the study area is a far from suitable methodology. With a very limited number of plots sampled across such a large survey area, the results of the PATN analysis are far from robust and can not be used for sound decision making.

b) Inappropriate seasonality of surveys

Surveys for the assessment were undertaken over a very limited period at the beginning of Autumn – this is an inappropriate season for survey for a large number of taxa and has contributed to overall poor survey results and a lack of reliability of survey results

c) Lack of adequate level of stratification of fauna survey sites

Survey sites were not located in representative samples of the study area. Sites were located to enable ease of access (all located at edges and disturbed habitats), thereby preventing the results of the assessment being used as a reliable assessment of the biodiversity of the study area.

d) Lack of consideration of broader impacts

The assessments have presented mapping and consideration of impact within a very narrow corridor, limited to the footprint of the Route Options. In order for impact to be adequately assessed, a broader consideration (mapping and ecological assessment) of adjacent and proximate habitats is required.

e) Lack of adequacy of owl surveys

f) Lack of adequacy of bat surveys

g) Lack of adequacy of reptile surveys

h) Lack of adequacy of frog surveys

i) Lack of targeted surveys for a threatened fauna (eg. Bush Hen) known from the study area

2.5.2 Lack of mapping of Endangered Ecological Communities within the Route Options

There is no mapping of the extent of Endangered Ecological Community present within the study area. This is a major oversight and does not adequately portray the state and NATIONAL significance of the study area (the largest complexes of EECs present in the Lower Richmond Catchment).

The report states that five EEC's are present (yet not mapped) within the study area, yet there are 7 EEC's present. **EEC's need to be mapped and their extent documented.**

2.5.3 Lack of consideration of Corridors and Key Habitats

The study area supports the largest areas of Bioregionally significant Corridors and Key Habitats within the Lower Richmond Catchment. Route options publicly released, particularly in Section 2, fragment major Bioregional Corridors (linking Tuckean Nature Reserve, Broadwater National Park and Uralba Nature Reserve and private properties in the Rileys Hill, Bagotville, Meerschaum Vale and Coolgardie area) and fragments major areas of Bioregional Key Habitat. This has not been documented or assessed within the study.

2.5.4 Errors in the assessment of potential impact

Table 3.5 is fundamentally flawed. The scores derived for many of the threatened taxa in Options 2A-2C are substantially lower than should be, whilst those in Option 2F are considerably higher than should be. Threatened species records provided by myself in digital shapefile format to the RTA, Hyder and Geolyse have not been used in this assessment, nor has the data been included in maps of KNOWN threatened species records (see introduction). Numerous examples of incorrect scores are contained within the accompanying report.

A depiction of the extent of EEC's and the areas contained within Route Options is required in this section.

The literature sources mentioned within Table 3.1 "Conservation Status of Vegetation Communities" are not current or in some instances relevant. Furthermore the conclusions quoted in this table are flawed *viz.* Landmark Ecological Services, 1999) – quoting a study of Rainforests within Byron Shire, rainforests are recognised as Endangered Forest Ecosystems and many rainforest communities are listed as EEC's. Furthermore the conservation status of rainforests on the coastal lowlands in recognised as Very Poor (Floyd *pers.comm.*).

The use of Hager and Benson (1994) to determine reservation adequacy is incorrect and a poor and highly outdated depiction of reservation adequacy. The use of the North Coast Comprehensive Regional Assessment (CRA) as a benchmark for determining reservation adequacy and conservation status is essential.

2.5.5 Lack of consideration of broader impacts

The assessment has failed to document any areas of habitat outside the footprint of route options. A far broader consideration of impacts is required, the consideration of Corridor impacts has been detailed in point 3, however a range of other impacts will occur, notably hydrological impacts created by the construction of a six lane highway through hydrologically sensitive floodplain wetland complexes. There is abundant literature and local cases studies that demonstrate the destruction of identical wetland areas following road construction.

The consideration of broader impacts must also be made in relation to the availability of habitats for EECs and threatened species, both within the study area, as well as local availability. Habitats contained within the study area are recognised as the "only available" habitats for a suite of threatened species and the only areas of viable floodplain EEC within the Lower Richmond Catchment.

2.5.6 No structural assessments

A key consideration when detailing ecological significance is the documentation of structural condition. This is particularly the case for hollow dependent threatened fauna. Large areas of **Old Growth Forest** are located within the footprint of Options 2A-2C with several sections within the footprint of Option 2D. DEC has prepared structural mapping as part of the North Coast Comprehensive Regional Assessment that depicts large areas of mapped Old Growth Forest within Routes 2A-2C. **The study requires mapping and impact assessment of structural condition.**

2.5.7 Errors and omissions in vegetation mapping

There are substantial errors and omissions in vegetation mapping prepared for the assessment. A large area of Coastal Cypress dominated vegetation in the path of Route2A-2C has not been mapped, this vegetation community is of very high significance. Furthermore substantial areas of native vegetation to the east of Broadwater have not been mapped.

Vegetation mapping is incorrect along substantial sections of Options 2A-2C, where large areas of Swamp Forest and Sclerophyll forest are mapped as closed forest. Furthermore areas that are mapped as Swamp Forest are actually Closed Forest. The proportion of vegetation not mapped and incorrectly mapped is great; therefore there is a very poor level of reliability of the study for decision making purposes.

Majors areas of freshwater wetland on coastal floodplain (an endangered ecological community), in excess of 20 hectares have been located along Route 2C. These areas have not been identified in any project documentation, and raise serious concerns relating to the thoroughness of work undertaken by Geolyse Consultants. Furthermore, such areas are very poor landscapes for the construction of roads.

2.5.8 Lack of sound mitigation measures of literature to support claims made in Table

Section 4.2 "Mitigation Measures" is woefully inadequate when detailing mitigation measures. There is no relevant literature review and measures proposed **will not mitigate the impact of highway construction**. This section requires major additions and amendments.

2.5.9 Lack of consideration of Key Threatening Processes

The construction of a six lane highway will create many impacts recognised as Key Threatening Processes under the TSC Act. There is no consideration of many of the KTP's that will occur as a result of highway construction. Of major concern is "Alteration to the natural flow regimes of rivers, streams, floodplains and wetlands" and "Clearance of native vegetation", both will be created by the upgrade.

2.5.10 Examples of errors in project documentation

The report contains many errors. Notably is the mention made of *Grevillea hilliana* in the species list (page 108). This species is listed as Endangered on the TSC Act, yet has not been documented as such.

The report is of a poor quality and contains numerous errors scattered throughout, there are too many to detail in this summary review. eg. "Compo Fruit Dove" (page 84), presumably this is the Wompoo Fruit Dove???

2.6 CONCLUSIONS

Further concerns are contained within the full review document (NCC, 2005) that present in detail the immense number of errors, flaws and omissions in the entire assessment.

This summary document has demonstrated the magnitude of flaws, omissions and errors in the field assessment and reporting contained within the "*Flora and Fauna Assessment of Route Options*" and has concluded that they are of such concern that re-assessment is required.

The material presented to the RTA and Hyder Consultants in the "*Flora and Fauna Assessment of Route Options*" by Geolyse Consultants is of such a poor standard that no decisions can be made on this basis.

A large number of additional records of threatened species (several hundred) have been made during relatively limited independent assessments and the occurrence of numerous (15) threatened species not recorded by Geolyse Consultants (2005) was documented.

Native vegetation along Route 2C is of immense significance, this route contains the largest areas of old growth vegetation on the Richmond Floodplain.

Furthermore the area contains the largest populations in NSW of a number of threatened species and all Endangered Ecological Communities occurring in the Richmond Valley. The construction of a six lane highway in such a nationally significant area must not occur.

2.7 REFERENCES

Geolyse Consultants 2005. *Flora and Fauna Assessment of Route Options Phase 1 & Phase 2 Investigations – Proposed Woodburn to Ballina Pacific Highway Upgrade.*

Hager, T. and Benson, J. 1994 *Review of the Conservation Status of Forest Plant communities in Northern New South Wales*. Report to the Australian Heritage Committee.

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Maciejewski, S. 1994. The Ecology of the Grass Owl (*Tyto capensis*) in the Richmond Valley. *Mastes Thesis*, Southern Cross University Lismore

NSW Department of Environment and Conservation, 2002. *Corridors and Key Habitats Project.*

NSW Department of Primary Industries. 2004. Draft Recovery Plan for the Oxleyan Pygmy Perch (*Nannoperca oxleyana*)

3.0 GEOMORPHOLOGY

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August 2005

3.1 POTENTIAL ACID SULFATE SOILS

The Woodburn to Ballina Pacific Highway Upgrade project area is situated on coastal floodplain of low relief mapped by the then Department of Land and Water Conservation soil landscape series as Dungarubba soil landscape (Morand, 2001) and underlain by potential acid sulfate soils as shown in figure 1. Potential Acid Sulfate Soils (PASS) are formed in anaerobic low energy vegetated estuarine systems when sulfate (SO_4) from seawater combines with iron (Fe) from the soil in the presence of organic matter to form iron sulphide (FeS_2) known as pyrite. The distribution of PASS indicates the extent of Holocene tidal inundation 6,500 - 7,000 years ago (fig 3) when sea levels were approximately one and a half metres higher (Owers, 2002).

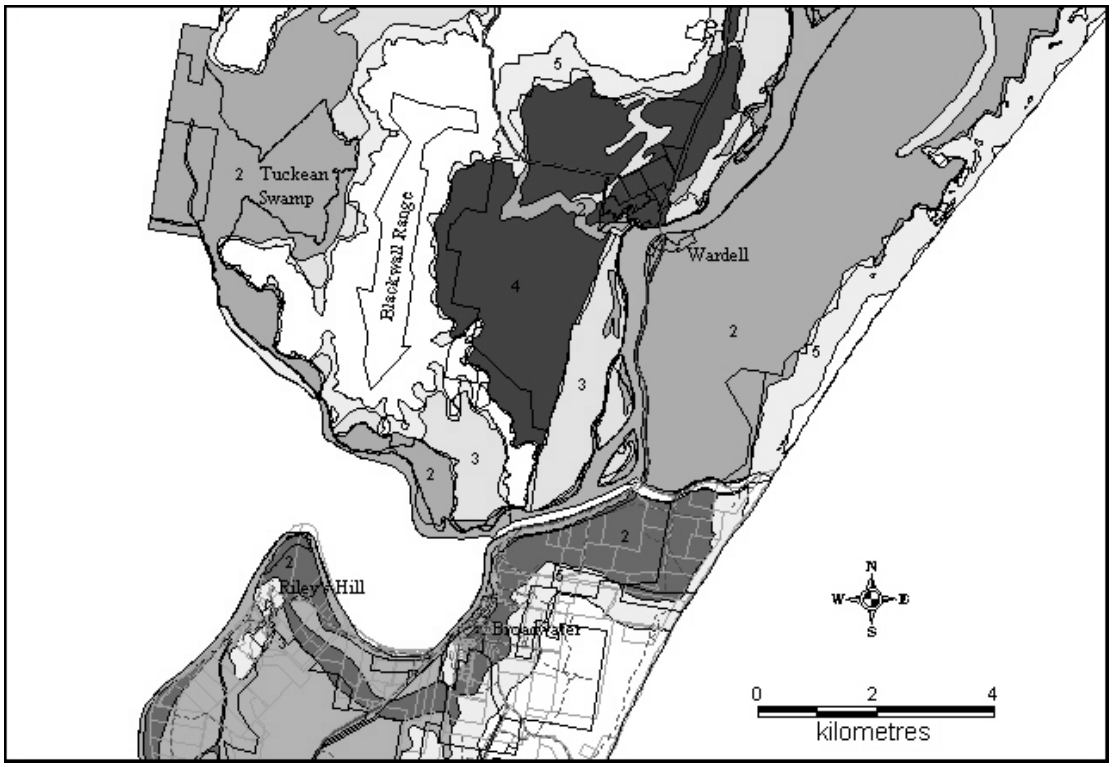

Figure 1: Distribution of Potential Acid Sulfate Soils (PASS) within the study area.

Pyrite remains stable under anaerobic conditions, such as when submerged by groundwater beneath alluvium. However when exposed to the air through drainage works, dredging, excavation or dewatering, pyrite can oxidise to form actual Acid Sulfate Soils (ASS). Acid sulfate soils leach sulfuric acid (H_2SO_4) and various iron oxide and hydroxide compounds into drains, creeks and rivers. Sulfuric acid has the potential to kill fish and dissolve metals naturally present in the soil, leading to metal toxicity in receiving waters. Acid discharge often involves the release of toxic aluminum when the soils alumino-silicate clay lattice is dissolved. Exposure of fish to sub lethal concentrations can result in lesions known as epizootic ulcerative syndrome or red spot disease caused by increased susceptibility to infection by *Aphanomyces sp*.

When dried ASS undergoes a ripening process the soil profile shrinks, permanently causing subsidence which can have major consequences for hydrology, agriculture, roads and bridges. Acidity can impact upon vegetation in low lying areas of land in ways similar to salinity forming bare and eroding acid scalds. Concrete structures such as bridges, pipes and culverts are attacked and eroded as sulfuric acid chemically reacts with the lime in the concrete. This can expose aggregates and the steel reinforcing then oxidises forming rust that expands causing cracking or concrete cancer. A large amount of time and public money has been spent to ameliorate the effects of past land use in PASS. It is now generally recognised that potential acid sulfate soils are best left undisturbed.

3.2 MONOSULFIDIC BLACK OOZE

Upstream watercourses of low salinity may also contain significant deposits of monosulfidic black ooze. Monosulfidic Black Ooze (MBO) is a black gel like substance that builds up rapidly on the surfaces of drainage channels. Deposition rates can be in the order of 100 mm per month to depths of greater than two metres (Sammut, 1996). MBO's are formed in anaerobic conditions when bacteria consume carbon to catalyse a chemical reaction between iron and sulphur forming iron monosulfide (FeS) known as MBO. When mobilised by flood flows or other disturbance MBO's react with the oxygen in the water, oxidising and stripping oxygen from the water, within minutes resulting in fish kills (Bush, Sullivan and Fyfe, 2002) as experienced in the Richmond River in March 2001. MBO's if allowed to dry on land will oxidise forming sulfuric acid and permanently shrink to less than half their former size.

3.3 PEAT

Peat is organic matter which has been deposited in anaerobic sediments, limiting breakdown and storing large amounts of carbon. Potential acid sulfate soils are commonly covered by a layer of peat that protects the soil by preventing it from drying out. Peat normally holds significant amounts of water, however drainage and associated drying exposes peat to combustion by fire. Once ignited, peat fires are extremely difficult to extinguish and can burn for months releasing acrid smoke, lowering the ground surface, causing repeated surface fire outbreaks and releasing stored carbon to the atmosphere. In land given to sugar cane production the peat layer is destroyed by repeated cultivation resulting in aerobic breakdown.

Placing a highway through a natural area containing peat will require drainage, with the highway then providing an ignition source exposing the peat to the danger of fire. By comparison routing of the highway through sugar cane land will result in no danger of peat fire.

3.4 SALTWATER BUFFERING

The carbonates (CO_3) and bicarbonates (HCO_3) contained in saltwater provide a high acid neutralising capacity (ANC), capable of neutralising or buffering acidity and therefore raising pH. Due to the effects of saltwater buffering, increasing salinity levels reduce the likelihood of the occurrence of MBO's and the detrimental effects of ASS on water quality. Downstream disturbance closer to the river mouth will therefore result in far less impact on water quality than an equivalent upstream disturbance.

3.5 WICK DRAINS

Wick drains are usually installed vertically in slots & used to speed consolidation by removing pore water from soft ground. They then may be covered by a layer of bottom ash, to remove water sideways, and pre-loaded with road base that sinks into the ground as the water is removed. If reduced sediments (pyrites) come out in the ground water it will oxidise forming sulfuric acid.

Many areas underlain by PASS are overlain with impermeable clay layers forming confined aquifers, which maintain groundwater levels by reducing surface discharge and evaporation. Impermeable clay layers also maintain anaerobic reducing conditions by preventing air infiltration into the soil profile. Wick drains can convert confined aquifers to unconfined aquifers, lowering water tables and allowing air into former anaerobic sediments, thus allowing pyrite oxidation. As air enters the profile jarosite [$KFe_3(SO4)_2(OH)_6$], a pale yellow precipitate will form around the wick drains. Jarosite can hydrolyse to the iron oxide goethite [FeO.OH] liberating more acid (Sammut, 1996).

Under a continuous road the consolidated material will form a barrier to the movement of groundwater, increasing ground water levels on the high side and causing abnormal groundwater discharge, while reducing groundwater levels on the down slope side which then could cause drying & acidification of the soil. Wick drains allow faster consolidation making it more feasible to build a road across soft ground however they can have severe environmental consequences.

3.6 EUSTATIC SEA LEVEL CHANGE

Eustatic sea level change is defined as variations in sea level due to climate change. Past global climate change is believed to have been triggered by variations in solar radiation due to the Earths orbit eccentricity around the sun, axial tilt and precession of equinox and solstices. Low solar radiation may result in global cooling, glaciations and low sea levels, while high solar radiation may cause global warming with retreating ice cover and higher interglacial sea levels (Dawson, 1992).

Falls in sea level due to global cooling expose more land surface and results in the cutting of new river valleys through the erosion of deep estuarine sediments. Extensive Pleistocene glacial periods prior to 15,000 years ago resulted in a sea level drop of between 80 and 130 metres. During this time rivers cut deeply into coastal sediments forming deep valleys (Hudson, 1995).

3.7 PALAEOVALLEYS

Holocene sea level rise caused the inundation of the deep Pleistocene river valleys (fig 3), filling them with sediments and creating palaeovalleys. The location of palaeovalley sediments, shown in figure 2, marks the position of coastal rivers during the last glaciation (Hudson, 1995). Palaeovalley sediments are composed of estuarine clays, muds and gels with depths exceeding 40 metres and widths of up to 2,000 metres. While the land based palaeovalley sediments north of Broadwater do not form a barrier to road construction, these sediments, when located either side of a major watercourse, form a very poor foundation for a major bridge. Bridge construction would require deep excavation in excess of 40 metres to bedrock resulting in high cost.

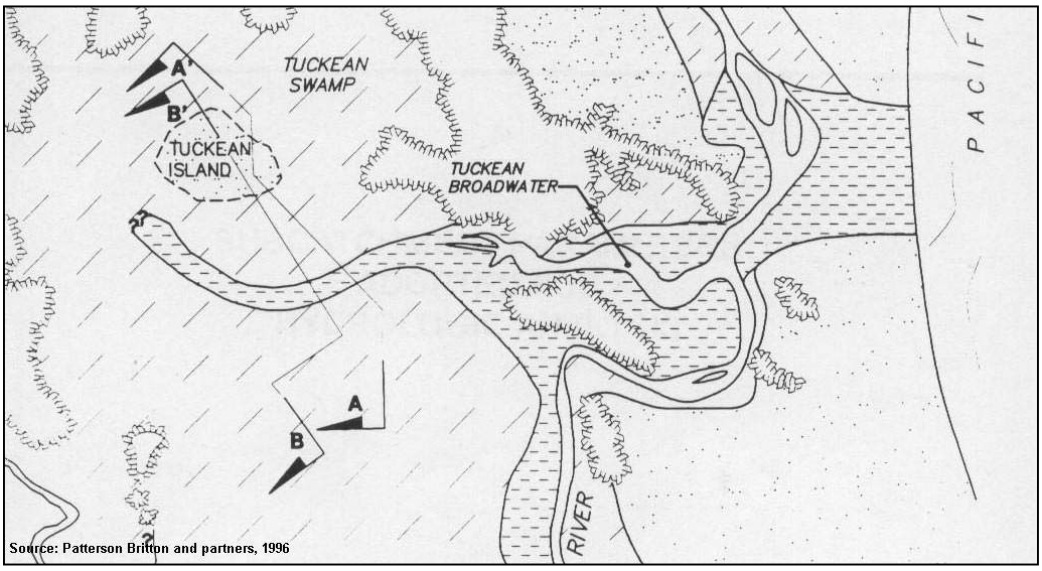

Figure 2: Location of Palaeovalley sediments within the study area.

3.8 GLOBAL WARMING

Global warming has the reverse effect to cooling, resulting in the melting of the ice sheets, the thermal expansion of the oceans and increased evaporation and rainfall. When the volume of the oceans increases, the sea advances inland inundating previously dry land. Shifts of a maximum of 8^0C in temperature between glaciation and inter-glaciation generally occur over periods of thousands of years (Williams, *et.al.,* 1993) however anthropogenic warming predicted by the effect of global dimming could result in a 2 ^{0}c rise by 2030 and 10 ^{0}c by 2100.

By 2100 sea level rise due to anthropogenic global warming has been predicted to be as much as 7.5 metres. Only a 1.5 metre rise is required to re-inundate coastal areas to the maximum level achieved 6,500 years ago as shown in figure 3. The predicted 7.5 metre rise in sea level would place the flood free highway at least 3 metres under water.

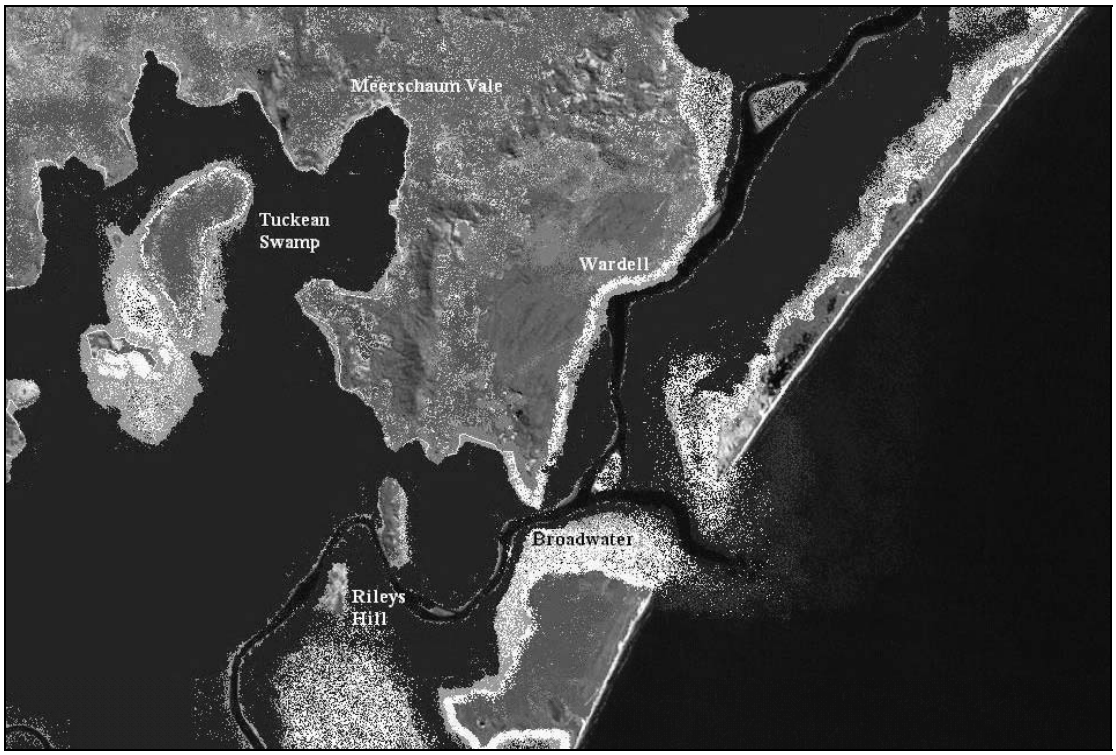

Figure 3: Holocene sea level inundation 6,500 years ago. Source: Owers, 2002.

3.9 FLAWS IN RTA/HYDER GEOTECHNICAL ASSESSMENTS

The assessments undertaken by Coffey Geosciences for the Woodburn to Ballina Upgrade are not of sufficient detail and coverage of the landscape to enable sound decisions to be made regarding route selection and preferred options. In particular, a review of the Coffey Geosciences report has established that no test bore sites were sampled along the entire eastern section of the study area, between Broadwater and Wardell, yet an abundance of test bores were established along the Laws Point to Meerschaum Vale area. The reliability of geotechnical assessments undertaken for the refinement of a preferred route in the Woodburn to Ballina Upgrade is therefore questionable.

Furthermore no sampling has been undertaken within extensive wetland complexes (supporting large peat layers) that occur across approximately 60% of the length of Route 2C. Independent sampling of groundwater has shown the presence of substantial groundwater reserves within 200mm of the surface across approximately 30% of the length of Route 2C. These areas are far from suitable for road construction and remain entirely unassessed or unrecognised by Hyder Consulting and the RTA.

Sampling of the hydrogeology of Route 2C was undertaken in early August 2005 (Peter Volk, Coffey Geosciences *pers. comm.*) on the basis of photographs taken in a single day from points accessible by two wheel drive vehicle. This is not a sound means of determining hydrogeological function of Route 2C and does not provide any meaningful data to enable design, refinement or assessment of route suitability.

3.10 CONCLUSION

Construction of the Upgrade of the Woodburn to Ballina Section of the Pacific Highway must be undertaken along the existing alignment (or as close as possible to it) to ensure that impacts upon geomorphologically unsuitable areas are prevented.

A review of geotechnical assessments undertaken for Hyder Consulting and the RTA by Coffey Geosciences has identified that the assessment has failed to objectively or systematically sample the study area, instead concentrating sampling within a small proportion of the entire study area. This has not provided the RTA (and therefore the taxpayers of NSW) with an objective depiction of the geotechnical considerations in constructing a highway upgrade between Broadwater and Wardell and can not be confidently used for decision making.

As large areas of wetland and substantial groundwater reserves have been identified during independent field sampling undertaken by the Blackwall Highway Action Group and have not been assessed by Hyder, Coffey Geosciences or the RTA, the basis of route selection is fundamentally flawed.

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4.0 SOCIO ECONOMIC IMPACTS

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August 2005

4.1 SOCIAL IMPACTS

Options 2A-C of the Woodburn to Ballina Pacific Highway Upgrade will have massive adverse social impacts upon the communities of Laws Point, Bagotville, Meerschaum Vale, Meridian Heights and Coolgardie. These areas are at present completely unaffected by any impacts from the Pacific Highway. Furthermore, no highway related impacts upon pollution, acoustic conditions, amenity or economic development and property values occur within this area.

Many of the residents along the alignment of Route 2C were born on and have remained on family owned properties all their lives. A number of properties along Route 2C have considerable local social value, with one site in particular having been used as a Picnic Area for the local Presbyterian Church for over 40 years. The destruction of social fabric and loss of community caused by construction of Route 2C will be immense and unmitigable.

4.2 ACOUSTIC IMPACTS

The Blackwall Range is the dominant landform along the length of Route 2A-2C. The nature of the terrain of the Blackwall Range is one of a series of natural “amphitheatres”. The acoustic impacts on residences adjacent to Routes 2A – 2C along the edge of the Blackwall Range has not been assessed during studies for the Woodburn to Ballina Pacific Highway Upgrade.

With the presence of extensive areas of coastal escarpment adjacent to the coastal plain, the extent of highway related acoustic impacts upon presently unaffected areas will be great. Sixty residences are located in close proximity to Route Option 2C, many of them located along the escarpment of the Blackwall Range, the acoustic impacts upon these presently unaffected by highway acoustic impacts is unacceptable. Acoustic mitigation measures will not be feasible in this area due to the coastal escarpment being positioned over the proposed highway route.

4.3 AMENITY IMPACTS

The entire length of Options 2A-2C is at present unaffected by the presence of a major highway. The area is characterised by a series of quiet rural valleys and large areas of undisturbed native vegetation. All residents in the area have chosen to live in the area for the rural amenity, general peace and quiet and for the diversity and abundance of flora and fauna.

The area contains numerous vantage points of an extensive area of coastal vegetation and the coastline of the Richmond Valley. The main components of the scenic amenity of the area are the undisturbed areas of native vegetation (including old growth forest) abutting agricultural areas and rural residential enclaves. The creation of a scar on the landscape resulting from construction of a six lane highway will permanently alter these sweeping coastal and native vegetation views and destroy the amenity of the area.

The construction of a six lane highway through what are at present valleys entirely unaffected by highway impacts will permanently and irreversibly alter the amenity of these rural residential areas. One of the primary desirable attributes of this area is the rural amenity with agricultural areas adjoining extensive areas of diverse native vegetation, these values will be lost forever should the Pacific Highway be constructed through areas that are at present over 4.5km distant.

4.4 ECONOMIC IMPACTS

The length of route 2C supports a diversity of economic uses from agricultural production to nature based tourism and ecosystem services. In addition many of the properties within the area have considerable value due to the sought after coastal locality and diversity of views.

Major impacts upon a range of agricultural enterprises can be expected along the entire distance of Route 2C. In particular major impacts upon Cane Farms in the Bagotville and Meerschaum Vale areas, and large grazing enterprises from Laws Point, Bagotville, Meerschaum Vale and Coolgardie will occur. Specialised vegetable cropping enterprises are located at Bagotville (Sweet Potatoes, Onions, Brassicas and Potatoes in particular). This enterprise provides a substantial proportion of all vegetable products produced in the region.

Australia's largest Lotus enterprise is located at Meerschaum Vale, and the entirety of this important industry will be lost to Route 2C, as will opportunities for expansion of the fledgling specialist wild harvest bush food industry in the area (the fastest growing agricultural industry in the region).

Nature based tourism opportunities abound in the area through which Option 2C is proposed. At present a substantial income is derived from nature based tourism including activities such as bird watching and bush walking. An industry has emerged around the presence of the most diverse orchid habitats in the north of NSW with orchid and wildflower tours in the areas being increasingly recognised nationwide. These burgeoning industries will be destroyed with the construction of Option 2C.

There are immense benefits to society from the ecosystem services being provided by extensive wetlands and old growth forests along 2C. In particular these areas provide clean water for drinking and ultimately to the Richmond River estuary, as well as major benefits of Carbon sequestration (reduction of greenhouse gas emissions).

The construction of a six lane highway through these areas will not only remove the ecosystem services they provide, but create major additional greenhouse gas emissions from the clearance and destruction of native vegetation and the release of carbon dioxide, methane and other greenhouse gases that are at present organically bound.

The primary asset of the majority of people living along Route 2C is their principal residence and over 95% of residents own a single dwelling. With 60 houses located in very close proximity to Route 2C the loss of property value (peoples primary source of wealth). Utilising conservative property value deductions, over $7 million dollars will be lost from property values along Route 2C should the highway be built. This is a major loss of wealth from the local economy and will have significant negative spin-off effects upon the stability of families, the ability to borrow against property holdings and the general affluence of the area.

4.5 AIR AND WATER QUALITY IMPACTS

With the presence of extensive areas of coastal escarpment and the existence of substantial inversion layers adjacent to it, the trapping of toxic atmospheric pollutants will occur (refer to next chapter for a review of toxic pollutants from highway traffic). All residences in the area are dependent upon rainwater tanks, these will be unacceptably contaminated should the Pacific Highway pass through this otherwise unpolluted area.

Furthermore extensive high quality groundwater reserves exist in sandplain sections of Route 2C, particularly to the west of Laws Point, between Thurgates Lane and Old Bagotville Rd, between Wardell Rd and Lumleys Lane and adjacent to Kays Lane. The sensitivities of sandplain aquifers to pollution and contamination is well documented (Swan Coastal Plain and Moreton Bay studies) and the construction of a six lane highway atop and within major sandplain aquifers will lead to major declines in water quality.

4.6 NON-INDIGENOUS CULTURAL HERITAGE

A large number of sites of high cultural heritage value exist along the alignment of Route 2C. Historic houses exist at Laws Point, Bagotville, Meerschaum Vale and Coolgardie. The oldest house "Oakvale" between Wardell Rd and Lumley Lane was constructed in the 1880's and is the oldest remaining homestead in the area. Furthermore an historic house "Neranleigh" in the Lumleys Lane area was built in the early 1900's from a single log and remains in the family's hands to this day. Photographic evidence of the construction of this house is available.

With the construction of a six lane highway adjacent to these houses of exceptionally high cultural heritage value most heritage values will be lost. These houses, all older than 100 years, are of exceptional significance and still remain in their original landscape context, of agricultural lands abutting extensive areas of native vegetation. This context and heritage value will be forever destroyed with the construction of a highway adjacent to them.

4.7 INDIGENOUS CULTURAL HERITAGE

Due to the landscape position of Route 2C there are extensive areas of high indigenous cultural heritage. Of particular note is the presence of the highest density and largest number of scar trees in the Lower Richmond Valley. At least twenty scar trees have now been recorded along Route 2C – studies undertaken for the RTA only found two sites with scar trees present – Laws Point and Thurgates Lane. Independent field inspections have located many additional scar trees to the north of Laws Point and the south of Old Bagotville Road.

As the forests within and adjacent to Route 2C are the largest areas of old growth and mature forest in the Lower Richmond Valley, the highest densities and numbers of scar trees occur in this area. The loss of a single scar tree is unacceptable in an area where so few exist and so much indigenous cultural heritage value has already been lost.

4.8 BUSHFIRE MANAGEMENT

All roads represent a potential source of bushfire ignition from carelessly discarded cigarette buts to traffic accidents and arson; the more traffic, the higher the resulting potential. Unlike other types of roads, freeways, due to the presence of continual crash barriers, do not allow access off the sides of roads for emergency vehicles. While some sections may include a parallel local road most will not.

Fighting fires initiated from the freeway, subject to smoke obscuring 110 kilometres per hour traffic, while not able to park fire vehicles safely off the highway presents a major threat to life. It is therefore reasonable that local Bushfire brigades would refuse to fight fires from freeways without police or RTA traffic control in place. The location of interchanges and emergency U turns is also a major factor in response times. The Wardell Brigade, which services the current highway, would have a longer response time. If the freeway diverted towards the east, the Meerschaum Vale Brigade would be geographically closer however response times would be much slower due to the need to access via a distant interchange.

4.9 CONCLUSIONS

The Upgrade of the Woodburn to Ballina Pacific Highway section must occur along the existing alignment in order to limit social and economic impacts upon communities at present entirely unaffected by highway related impacts. Furthermore the high significance of Indigenous and Non-Indigenous Cultural Heritage in the area must be retained; construction of a highway along Route 2C will destroy these values forever.

5.0 TOXICITY OF DIESEL FUEL EMISSIONS: IMPLICATIONS FOR THE PROPOSED PACIFIC HIGHWAY UPGRADE.

PARTICULAR REFERENCE TO THE WOODBURN - BALLINA SECTION

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5.1 INTRODUCTION

Diesel and/or petrol fuels are significant sources of polyaromatic hydrocarbons (PAHs), particulate matter and Dioxins (Scheepers & Bos, 1992; US EPA 1997; Pohjola et al, 2003; Lloyd & Cackette, 2001), as well as oxides of nitrogen and sulphur containing compounds. Dioxins, PAHs and the particulate matter, with particular reference to the proposed RTA routes between Woodburn and Ballina, are the main subject of this submission

This submission does not discuss the effects of the nitrogen oxides nor the sulphur compounds as these effects would apply *wherever* a major road is sited, and also because the governmentally legislated progressive reduction in allowable sulphur content in fuels will reduce sulphur compounds and, to a lesser degree, particulate matter. However it must be noted firstly that both petrol and diesel produce these substances and, secondly, that routes 2A to 2D inclusive all cross the mangroves wetlands through the major fish nursery (RTA/Hyder Report) of the Richmond River and as such, the sulphur compounds (independent of other toxic diesel emissions) may represent a significant risk to the health and numbers of marine life in the river until such time as the use of sulphur containing fuels is significantly reduced. This will not be until at least 2009 (Commonwealth Department of Environment and Health Guidelines). The risk of potential dioxin contamination at these sites is discussed below.

5.2 HEALTH EFFECTS OF DIESEL FUEL EMISSIONS

Acute (as opposed to chronic long term) exposure is known (Scheepers & Bos) to cause eye and respiratory tract irritation, exacerbations of asthma and chronic airways limitation and may exacerbate existing cardiovascular diseases (eg angina).

In the 1990s, the International Programme on Chemical Safety (IPCS) 1996, and the International Agency for Research on Cancer (IARC) 1989, both recognised the association between long-term diesel exhaust exposure and lung carcinoma. In a review article, with 140 citations, Scheepers & Bos found long term effects include chronic airways limitation (chronic bronchitis/emphysema), lung and bladder malignancy. These effects are acknowledged associations of exposure to the PAHs and particulate matter found in diesel emissions.

Note that long-term inhalation exposure is associated with an increased risk of bladder carcinoma, suggesting systemic absorption occurs, as the bladder malignancy occurs at a site not in direct contact with the emissions. Tintinalli and Goldfranks confirm that aromatic and halogenated hydrocarbons *are* lipid soluble and that significant systemic absorption does occur *with ingestion* as well as inhalation.

The above effects have been detected in population cohorts with long-term exposure to the emissions. The proposed mechanisms are complex and may be associated with particle effects, particle bound organics and/or gas phase substances. Pohjola et al (2003), found that the quantity of DNA adducts produced in diesel fuel was 11 to 30 times (dependent upon diesel grade) that produced by petrol fuel. DNA binding and thus genetic alteration is one of the main methods of carcinogenesis and mutagenesis.

In addition to the PAH and particle effects, in recent years the class of organic compounds known as "dioxins" (which here-in will include "dioxin like substances") has been increasingly recognised as one of the most potent and toxic known (Mukerjee, 1998). Unlike the PAHs and particulate matter, it is thought that dioxins usually accumulate slowly in humans. Dioxins are highly lipophilic substances that are only very slowly metabolised by the human body; the half-life in our bodies varies from 3 years to 50 years. They are concentrated going up the food chain with the result that they accumulate in our bodies when "top of the chain organisms", like humans, ingest them. (Note that there is very little good human data on inhalational or dermal exposure.) "Agent Orange", of Vietnam fame, contained dioxins as a contaminant thought to be responsible for a large part of its deleterious human effects.

Note that dioxins and dioxin like substances are a class of chemicals sharing the characteristics of persistence in the environment, capable of producing the same effects as the stereotypic dioxin (PCDD) but of varying potency. The usual method to compare toxicity amongst the class is to employ a calculated "TEQ", or toxicity equivalent, which references against the toxicity of PCDD. All measures quoted here-in are in terms of TEQs.

Dioxins are produced by combustion processes in the presence of a chlorine donor and then dispersed atmospherically to contaminate surrounding water and land. Because the main long-term effects result from the slow accumulation in humans, as result of constant ingestion of contaminated food and/or water, trace quantities present in the atmosphere do not seem to present a proven imminent threat. However, the demonstrably elevated dioxin contamination in soils around major roads indicates that dioxins are dispersed locally.

Most of the available human experience is from transient but high dose, industrial accident or food contamination exposures; the evidence from which has been studied extensively by the World Health Organisation and the US Environmental Pollution Agency (amongst others). Extensive animal experiments have confirmed the toxicity of these substances. Effects include foetal death, birth malformation, infertility, abnormalities in the development of the nervous system in children, carcinomas (not organ specific), endocrine abnormality, liver function abnormality, adenoma of the liver, hepatic failure, immunotoxicity, and dermal toxicity (WHO Consultation 1998; US EPA, Dioxin Reassessment, 2004). These are effects seen either in experimental animals or in humans after acute exposure to large doses or both. The US EPA has stated they have doubts as to the ability of our current science to accurately determine the effects of low levels of chronic dioxin exposure in humans (NH&MRC 2002).

Significantly, the maximum daily provisional tolerable exposure recommended for dioxins has been reduced 10 fold in the last ten years. The United Nations World Health Organisation (WHO), the Australian National Health and Medical Research Organisation (NH&MRC), European Union (EU) nations all have maximum **provisional** tolerable intakes equivalent to between **1 and 10 picograms** (10^{-12} grams) per kg bodyweight per day. The US EPA is unwilling to recommend a tolerable regular intake as their built in safety factor would produce a recommendation *between 100 and 1000 times less than the current actual average intake*. The tolerable exposure levels are based upon extrapolations from the acute industrial exposures and the animal data. They are acknowledged to be provisional only, and subject to further change.

The NH&MRC review (Oct, 2002) reveals that the existing average intakes (of dioxins and dioxin like chemicals) in industrialised countries is already in the range recommended above. It also states that Canada has significantly reduced dioxin levels in fish and shellfish by restricting water contamination from industrial sources, especially bleach paper mills. The WHO has already suggested that pregnant women limit their ingestion of certain Atlantic Ocean and Baltic Sea fish to avoid dioxin exposure and risk of miscarriage or birth defect. In Tasmania there are ongoing legal issues over dioxin emissions, into water, from paper mills. All of this tells us that water borne dioxins are a significant source of our food contamination, and that contamination of waterways, especially fish breeding grounds, needs to be avoided.

5.3 DIOXINS IN DIESEL EMISSIONS.

Dioxins are produced in diesel emissions. Gullett and Ryan (1997) used a US EPA standardised emission test protocol to determine the dioxin (PCDD and PCDF) output of two prime movers, with loaded trailers, under both city and highway conditions. The results are summarised in the table below;

Nanograms of dioxins produced, *per kilometre* during US EPA standardised emission test protocol.
(Note that 1 nanogram = 1000 picograms)

	Peak produced (95% CI)	Average
Per kilometre	0.106ng	0.029ng
Extrapolated per year	16.1 grams	4.4 grams.

To put this in perspective, one truck, in one kilometre, could produce about 1.5 times the amount of dioxin that the Australian National Health and Medical Research Council considers as the provisional tolerable daily intake.

5.4 QUANTITIES OF DIOXINS PRODUCED.

The estimates below are very rough. There have been no studies on dioxin emission by Australian trucks, and the emission legislation (Vehicles and Traffic Act, 1993; Road Transport Reform Rules2001, Rule 147A) in fact covers only Oxides of Nitrogen, Particulate Matter and Visible Opacity. The use of cleaner fuels and various pollution reduction techniques (like particle traps and catalytic converters) will probably reduce these emissions (but will further raise the cost of running diesel engines independent of the effects of peak oil on fuel cost and availability).

From the RTA Route Options Development Report (pp. 30 – 32), in 2004 the Pacific Highway, in the study area, carried approximately 10,000 vehicles per day of which 16% (table 3-1, p.32) were heavy vehicles. ie. 1,600/day (but unofficial sources place that figure at around 2,000 per day). The RTA report (p.36) projects a daily volume of between 13,900 and 17,500 per day by 2034, based upon projected local population growth and recent linear growth in road usage. These assumptions do not allow for the previously observed increase occurring as a direct result of a faster, more fuel-efficient route being available. This was seen between 2001 & 2004, as result of the Chinderah bypass and the gazetting of B-doubles on the Pacific Highway, where both numbers and percentages (of total traffic) of heavy trucks increased in a non-linear fashion. The actual numbers are likely to be much higher.

Using the RTAs *current* figures and the average *(not the upper limit)* dioxin production as above, the highway between Woodburn and Ballina may **currently** produce up to 742,400pg of dioxins per day (or 270,976,000pg per year). The Australian recommended provisional tolerable intake equates to around 2pg/kg/day.

A single truck could emit an average of 106,000 picograms travelling from Sydney to Brisbane.

5.5 REGULATIONS ON DIESEL EMISSIONS, FUEL QUALITY.

The current regulations for in-service Diesel emissions are determined by the Australian Transport Council (www.ntc.gov.au). There are no emission controls for dioxins.

Enforcement/Implementation of these standards devolves to the individual States and Territories, but is co-ordinated by the federal Environment Protection and Heritage Council (www.ephc.gov.au) via the National Environment Protection (Diesel Vehicle Emissions) Measure (NEPM). As far as I can determine from the 2003/2004 annual Report, there is no testing for dioxins and little introduction of particle traps and catalytic converters, and, of note, there is little available information on the efficacy of these technologies in reducing dioxin emissions.

Fuel is regulated separately by the Commonwealth Minister for Environment and Heritage under the Fuel Standards Act. (www.deh.gov.au/atmosphere). There is an ongoing reduction in sulphur content that will moderate particulate emissions. Of note, any reduction of the aromatic hydrocarbon component in fuel will reduce the production of PAHs. This is an important step in reducing PAH and particulate matter carcinogen production, but will make fuel more expensive and has not yet been implemented.

To summarise:
1/ there are no regulations, technologies or investigations regarding diesel dioxin production in Australia.
2/ the strategies to reduce particulate matter, PAHs, Sulphur compounds and Nitrogen Oxides will make fuel more expensive, and are only in the investigational stage or in their infancy.
3/ there are currently no strategies specifically directed at identifying or reducing dioxin emissions.

5.6 PARTICULAR RELEVANCE TO THE WOODBURN TO BALLINA STUDY AREA

Diesel emissions clearly present a significant health threat. Any route that potentially contaminates fish stocks, waterways or drinking water must be excluded. Residents of the towns on the existing highway use town water and are therefore not subject to the health threat posed by contamination of tank and ground water.

1/ The route proposed through the Bundjalung National Park crosses the Evans River through the mangroves, which are major breeding grounds for prawns and other fish. This represents a health risk to consumers and also represents a threat to a major commercial prawn and fishing industry. It also passes numerous houses where the residents rely upon rainwater tanks for drinking water. Atmospheric dispersal of dioxins (and other pollutants) represents a major health risk to these people.

2/ All the Western Routes in Section 2 (2A, 2B, 2C and 2D) will put local residents at risk of drinking water contamination. Essentially every house along these routes is reliant upon tank (or clean groundwater) for drinking. In this Western area there are many more residences reliant upon non-town water than in the Eastern area.

3/ Options 2A & 2B require two long water crossings- Richmond River and Tuckean Broadwater. The Tuckean Broadwater in particular is a significant fish breeding ground and as such, contamination is a serious threat to consumer health as well as to the fishery itself.

4/ Options 2C & 2D cross the river just north of Broadwater town. This again is lined with mangroves, is tidal and is a major fish breeding area

5/ Option 2F affects fewer households, but does affect some. There is only one river crossing, not in a breeding area.

6/ Route Options 2A to 2C (inclusive) pass along the edge of Wardell Mountain and the Blackwall Range. This area will potentially trap exhaust emissions resulting in increased exposure to local residents.

7/ Options 2A to 2D all cross significant wetlands north of the Richmond River. Dioxin accumulation here will likely impact heavily upon the fertility and numbers of over 50 threatened species, particularly wetland birds and frogs. It will also leach into the aforementioned fish nursery areas. Option 2F passes across cane fields where there is little residual native flora and fauna.

The RTA report seems to reveal a lack of recognition of these issues.

To summarise, the only rational route is to duplicate the existing highway and to divert around towns where the townsfolk request it. The RTA has apparently rejected this option, leaving route 2F as the route with the minimum (but still unacceptable) risk to people both locally and through contamination of fish.

5.7 CONCLUSIONS

Diesel emissions contain several known toxins. These include dioxins, PAHs, Sulphur compounds, oxides of nitrogen and particulate matter. Current and planned government initiatives will probably reduce sulphur, nitrogenous oxides, particulate matter and possibly PAHs, but little is known about effective control of dioxins.

Dioxins are highly toxic residual environmental poisons with effects upon fertility, cancer promotion, birth defects, spontaneous abortion, neurological development, and liver disease (etc). In Australia we already consume close to the NH&MRC provisional tolerable ingestion limits. They **are** produced by diesel trucks, but the quantities produced by the Australian diesel fleet is not known. The projected rise in diesel truck use elevates even further the risk to human health.

The cost of oil will continue to rise as demand increases but available resources decline ("Peak Oil"). The cost of oil will also rise as a result of the (absolutely imperative) initiatives to reduce toxicity of emissions.

In the Woodburn to Ballina Section of the highway, there is no route option that does not compromise the health of at least some residents. The health impacts would be less with any option east of the river.

Passage of the highway across fish breeding grounds will result in contamination of fish and prawn stocks producing human contamination and potentially damaging an important commercial fishery, as well as local tourism. Option 2F has the least impact from this point of view.

Finally, the economic, environmental and health costs of continuing to use diesel trucks as the major freight transport mode mandate that alternatives be found. It is irresponsible to spend the sums of money necessary to construct a 100 metre wide highway, designed for B-doubles at 110kph, through this terrain when we will soon be forced by rising fuel costs to find alternatives. Planning to remove the majority of interstate transports from the Pacific Highway would permit a road of less demanding design standard ("duplicate and divert"), still satisfy the safety issues and at the same time produce less impact upon the health and the environment of the people of NSW.

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6.0 PEAK OIL

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August 2005

6.1 INTRODUCTION

Peak Oil is a term that describes the production pattern of oil over time, with particular reference to behaviour either side of maximum production. The concept was first discussed by the late Dr. M King Hubbert in 1956. Dr Hubbert was a senior research geophysicist working for the United States Geological Survey for 12 years. He was employed as director of Shell's research laboratory in Houston for 20 years. He taught at Stanford University, the Massachusetts Institute of Technology and the Johns Hopkins University.

Dr Hubbert described the production of oil from a reserve in terms of the sharp rise of production after the first well is drilled, the peaking, or plateauing of production when half the oil has been extracted, and the decline in production after that production peak. This production pattern forms the shape of a 'bell' curve, as displayed in fig. 1 below, and is described as the Hubbert Curve. This production pattern is typical of all oil reserves, the aggregated production pattern of a nation, and the aggregated global production pattern. Of particular concern was the decline of production once maximum production had been achieved. During this period, the oil pressure in the reserve decreases to the point where increasingly expensive technologies are required to extract the remaining oil. These technologies include pumping water into the well to pressurise the remaining oil from the reserve. The oil quality can also be reduced due to these technologies.

Dr Hubbert used this methodology to predict the production peak of US oil to occur in the early 1970's. His predictions were ignored, but were later proved correct, and this production peak in the US caused the oil spikes of that period. The steady decline in production in the US since that time has also been met with increased expense, as he predicted. Besides the Middle East, all other nations peaked in 1997. The world community of oil geologists and geophysicists are currently vigorously debating the global production peak.

The graph below from the Association for the Study of Peak Oil and Gas (ASPO), April 2005 newsletter [1], describes global production from the various oil producing regions and illustrates the bell curve used by Hubbert to describe production.

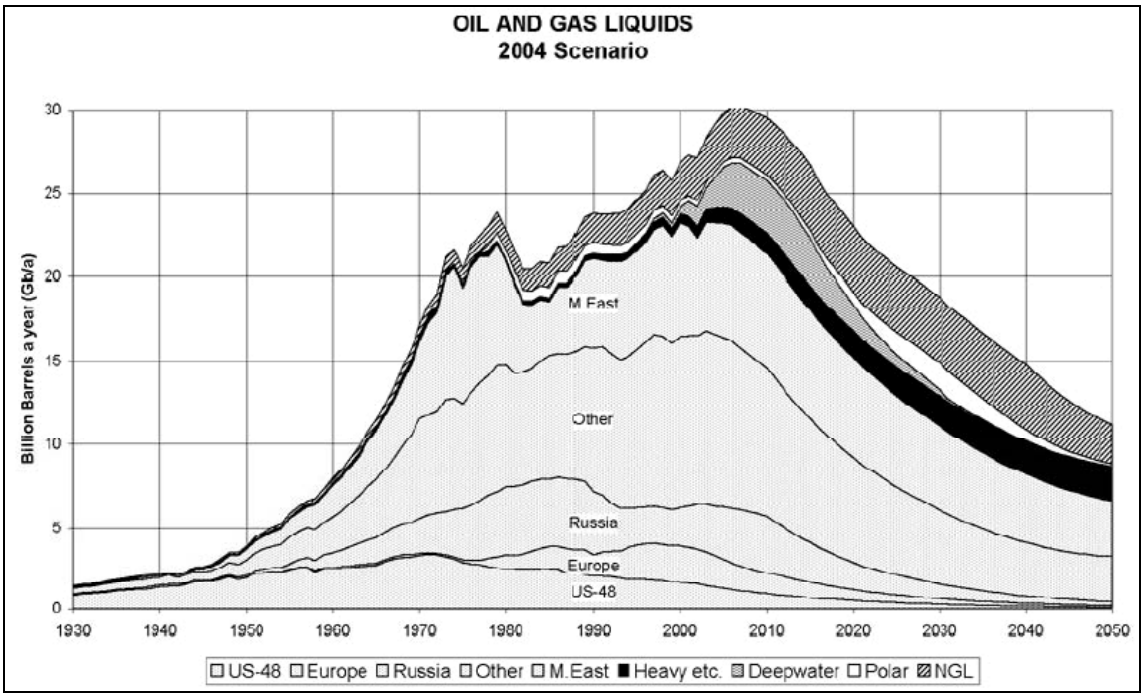

Fig. 1

As described by Hubbert, production patterns follow discovery patterns regarding oil and gas. The discovery pattern will follow a Hubbert curve, with the production Hubbert curve following some time after. The following graph from ASPO [1] shows discovery and production patterns since 1930.

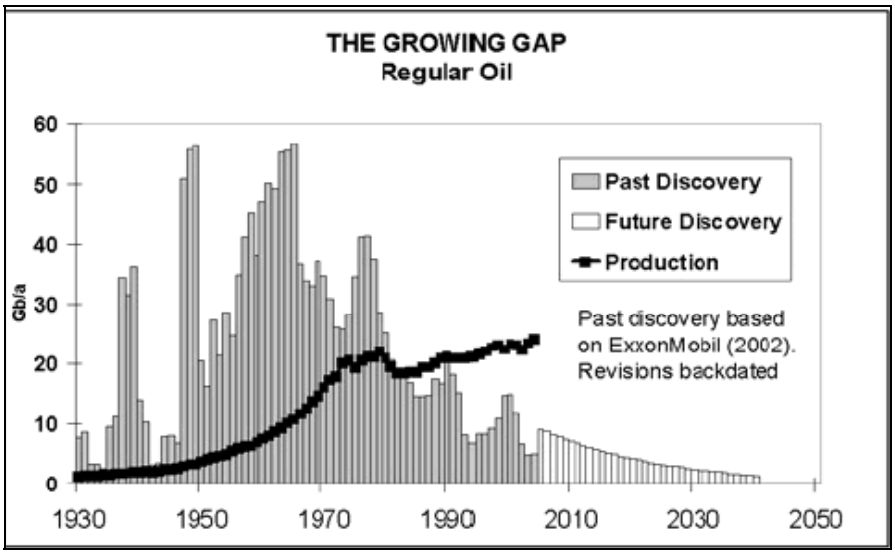

Fig. 2

The parliamentarian Andrew McNamarra [2], in his address to the Queensland parliament on 22 February 2005, when describing oil discoveries, stated - *New oil discovery across the world peaked in 1960 and we now find one barrel of oil for every four we consume. The six giant Saudi oilfields that produce the entire eight million barrels a day of Saudi production are all aged between 40 and 65 years. Nothing approaching the giant Ghawar field's size has been found in the last 50 years.*

Based on basic supply and demand economics, due to slowing production and soaring demand, the price of oil has increased over 500% since 1999 to the end of 2004, as illustrated on this graph from ASPO [1]. To date, August 2005, with the price at $68 per barrel, it has increased over 600%.

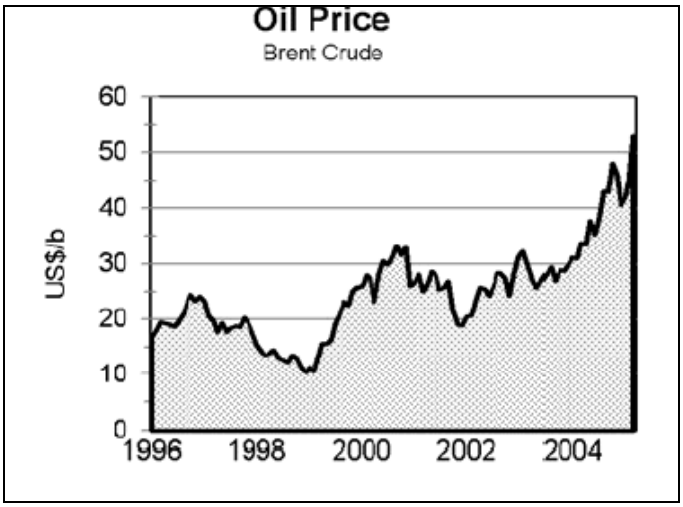

Fig. 3

Predicting global peak production is exacerbated by the fact that some countries have political motives for under-reporting or over-reporting their reserves, particularly in the Middle East, which hold the world's largest reserves and produces the majority of the world's oil. In the oil industry, a company's value is directly related to the value of its reserves, as is their OPEC production quota, so it is not surprising that reserve estimates can be considered to be somewhat higher than actual reserves. In the Middle East there are only market forces validating reserve estimates, but in the West, stock markets apply a validating influence on reserve estimates. An example of these reservoir-reporting inaccuracies is described by Andrew McNamarra [2] - *the Royal Dutch/Shell Group on 5 February 2005 cut its 2002 published estimate of its total oil and gas holdings by one-third. It reduced its 2003 estimate of oil reserves by 1.4 billion barrels, or 9.8 per cent, and admitted that two-thirds of its listed prospective wells in 2004 were in fact dry holes. Shell has been fined $US151.5 million for misleading stock markets.*

A significant number of oil geologists, politicians and investors have made public statements about the peak in oil production and its implications. The following are exerts of publicly reported statements from some of these people.

Dr Colin Campbell and Jean Laherrere in the Scientific American of March 1998 - *Using several different techniques to estimate the reserves of conventional oil and the amounts still left to be discovered, we conclude that the decline will begin before 2010.* Colin Campbell is a retired English petroleum geologist, who was chief geologist for Amoco, a vice-president of Fina, and has worked for BP, Texaco, Shell, ChevronTexaco and Exxon.
On 20 May 2005 the ABC released a press release of an interview with the former deputy Prime Minister, John Anderson [3] - *Deputy Prime Minister John Anderson believes high fuel prices reflect the inevitable decline in the world's oil and gas reserves. He expressed deep concern about the long-term future of oil and says fuel prices will have to be high enough to encourage more exploration. Mr Anderson says the world could reach peak production of oil and gas far sooner than predicted because of the rapid increase in energy demands in China.*

ExxonMobil Corporation, one of the world's largest publicly owned petroleum companies, in their report The Outlook for Energy: A 2030 View, forecast a global peak in five years. In the Business Magazine of 7 November 2004, Francis Harper of BP stated that he expects global oil production to peak between 2010 and 2020.
Errol Stock, an environmental scientist, interviewed on the ABC's Queensland Stateline, on 24 June 2005, stated that *Using the conventional oil reserves, the best forecast is somewhere between now and about 2035.*

Boone Pickens is a Texas oil tycoon, who started in the oil industry as a geologist for Phillips Petroleum, then founded Mesa Petroleum and Petroleum Exploration and is now Chairman of the hedge fund BP Capital Management. When addressing the 11th National Clean Cities conference in April 2005 [4] he said - *Global oil [production] is 84 million barrels (a day). I don't believe you can get it any more than 84 million barrels. I don't care what [Saudi Crown Prince] Abdullah, [Russian Premier Vladimir] Putin or anybody else says about oil reserves or production. I think they are on decline in the biggest oil fields in the world today and I know what's it like once you turn the corner and start declining, it's a tread mill that you just can't keep up with...So, when you start adding the reserves in these countries, you're not even replacing what you're taking out...84 million barrels a day times 365 days is 30 billion barrels of oil a year that we're depleting. All of the world's [oil] industry doesn't even come close to replacing 30 billion barrels of oil. We don't spend enough money to even give ourselves a chance to replace 30 billion barrels. It may be because the prospects are not there.*

Dr Ali Samsam Bakhtiari [5] is a senior planning expert with the National Iranian Oil Company. When interviewed on the ABC's PM program on 9 August 2004 he predicted peak in 2006/07, with the price of fuel at the bowser in Australia at $3-4 in 2007. When asked why the increased price of oil will not have the effect of reducing demand, thereby reducing the price of oil he stated - *Oh yes but not this time around. You will cut demand first but then the supply is going to go down as well. In the previous ones it was not like that. You would cut demand and supply would go up and you would recalibrate the whole system. This time you will not be able to recalibrate. What I'm saying is that you don't have any more spare capacity neither in the Middle East, nor in OPEC, nor anywhere else.*

James Howard Kunstler, in a speech he made in Hudson, NY on 8 January 2005 [6], made this observation on the differences between the 1970 crisis and the current looming production peak - *How did we get over it? The oil crises of the 70s prompted a frantic era of drilling, and the last great oil discoveries came on line in the 1980s - chiefly the North Sea fields of England and Norway, and the Alaska fields of the North Slope and Prudhoe Bay. They literally saved the west's ass for 20 years. In fact, so much oil flowed out of them that the markets were glutted, and by the era of Bill Clinton, oil prices were headed down to as low as $10 a barrel. It was all an illusion. The North Sea and Alaska are now well into depletion - they were drilled with the newest technology and - guess what - we depleted them more efficiently! England is now becoming a new oil importer again after a 20 year fiesta.* North Sea oil production peaked at 2.9 million barrels a day in 1999 and is set to fall to near half that level by 2007, which indicates how quickly production can decline from any one reserve.

In the article "Toward A Petro-Apocalypse" in Le Monde (Paris) on 10 May 2004, Yves Cochet [7] (Green), who represents Paris in the French National Assembly, and is former land and environment minister, writes - *The Hubbert's peak of the oil-producing Middle East should be reached around 2010, depending on the more or less rapid recovery of full Iraqi production and the growth rate of demand in China*. He urges European leaders and to plan for the coming peak, *Otherwise, rationing will come from the market through the coming rise in oil prices, and then be propagated by inflation, with the shock reaching every sector. Since the price will soon reach $100 a barrel, this will no longer be a simple oil shock.*

On 7 April 2005, the Financial Times (UK) published the article 'IMF warns on risk of 'permanent oil shock''. It stated - *Predicting surging demand from emerging countries and limited new supplies from outside the Organisation of the Petroleum Exporting Countries after 2010, Raghuram Rajan, IMF chief economist, said: "We should expect to live with high oil prices."... "The shock we see is a permanent shock that is going to continue...and countries need to adjust to that," said David Robinson, deputy IMF chief economist.*

Because of the fluctuating nature of oil production, it is impossible to determine exactly when the peak is occurring. The realisation of peak production can only be determined at some time after it has occurred, when there are no significant factors causing production to be reduced, and recorded production levels show a significant and continuous decline. Matthew Simmons, the Texas-based chief executive officer of the merchant bank Simmons & Company International, specialising in energy investments, and who served on President George W Bush's Energy Advisory Committee between 2001 and 2004.

On the ABC's Lateline program on 22 November 2004 he state*d - I don't think it is beyond the remote possibility that we will look back 10 years from now and say we actually had peaked, past tense, in 2004.* He says - *there are now just too many regions to ignore, which are now categorically beyond the peak.* Simmons published an article in Petroleum News in August 2004 in which he concluded that peak oil *could be the biggest energy issue the world has ever faced.* Simmons has done extensive studies of the Arabian oil fields, which supply the majority of the world's oil. Any failure in these fields will have significant effects on the current global supply of oil. In a presentation to the Hudson Institute on 9 July 2004, he stated his concerns regarding the Arabian fields. These concerns included intense water injection that is now required to pump the oil from the reserves, and where this process is masking the normal depletion pattern. He stated that Saudi Aramco has employed state-of-the-art geophysical tools to find new oil reserves and so far, the only commercial success has been in the Hawtah Trend reserve, which has produced a mere 200,000 barrels per day of extra light oil.

In an interview with Jim Motavalli for emagazine.com, Simmons states *Iran's oil peaked in 1971 or 1972 at six million barrels a day. And when it was at that peak level they had four fabulous fields that each produced over a million barrels a day. Each of those great fields now struggles to produce between 100,000 and 150,000 barrels a day. Iraq has two great fields, Kirkuk and Rumaylah, which have been about 80 percent of its production for the last 25 years. Kirkuk was discovered in 1927; it's the oldest producing field in the Middle East. Rumaylah was discovered in 1951. And those fields have been badly abused. And the real question is: Until Iraq develops some new fields, how much longer can Kirkuk and Rumaylah sustain the current 1.5 to 1.8 million barrels a day before they go into a production collapse?* Based on Simmon's concerns and the world's dependence on Middle East oil, we cannot afford to rely on optimistic faith in their continued production levels.

6.2 INCREASING DEMAND AND INCREASING PRODUCTION

With oil production, in order to ensure a consistent supply and thereby maintain a steady price, new discoveries of the resource need to be made at the same rate as the resource is being depleted from current supplies that are in production. As can be seen in fig. 3, this is clearly not happening. Robert Ryan, the General Manager of Global Exploration for Chevron-Texaco, states in the July issue of the AAPG Explorer that world new discovery is down to 40% of production. In other words, the companies are far from replacing their reserves in any real sense.

This situation is also described by US Vice-President Dick Cheney in 1999 when he was Chairman of Halliburton, in a speech he made at the London Institute of Petroleum Autumn lunch [8]. In it he said - *"From the standpoint of the oil industry obviously - and I'll talk a little later on about gas - for over a hundred years we as an industry have had to deal with the pesky problem that once you find oil and pump it out of the ground you've got to turn around and find more or go out of business. Producing oil is obviously a self-depleting activity. Every year you've got to find and develop reserves equal to your output just to stand still, just to stay even. This is as true for companies as well in the broader economic sense it is for the world. A new merged company like Exxon-Mobil will have to secure over a billion and a half barrels of new oil equivalent reserves every year just to replace existing production. It's like making one hundred per cent interest; discovering another major field of some five hundred million barrels equivalent every four months or finding two Hibernias a year. For the world as a whole, oil companies are expected to keep finding and developing enough oil to offset our seventy one million plus barrel a day of oil depletion, but also to meet new demand. By some estimates there will be an average of two per cent annual growth in global oil demand over the years ahead along with conservatively a three per cent natural decline in production from existing reserves. That means by 2010 we will need on the order of an additional fifty million barrels a day.*

A significant shortage of oil can occur if demand increases too fast for new production technologies to be implemented, and for new discoveries to be bought into production. This situation will cause oil prices to increase before global production reaches peak. Dr Ali Samsam Bakhtiari [5] - *with China's phenomenal economic growth, the worldwide demand is growing and growing, and now it regularly matches peak production of 81-million barrels a day.* China is becoming increasingly dependant on imported oil, not just because of soaring demand, but because its own oil fields have long since peaked. From the article 'As China grows, so does its oil thirst', published on Market Watch web site - *"China will increasingly rely on imported oil for domestic growth as domestic consumption soars while output stagnates," said Liu Keyu, a researcher at China Petroleum Economics and Information Research Center under the state-run China National Petroleum Corp. China's Daqing oilfield -- by far the nation's biggest -- produced just 50.1 million tons last year, down from a peak of 56 million tons reached in 1997.*

In an article in the Guardian on 21 April 2005 ("The end of oil is closer than you think"), it states - *"[The] International Energy Agency says developing countries could push demand up 47% to 121m barrels a day by 2030, and that oil companies and oil-producing nations must spend about $100bn a year to develop new supplies to keep pace... According to the IEA, demand rose faster in 2004 than in any year since 1976. China's oil consumption, which accounted for a third of extra global demand last year, grew 17% and is expected to double over 15 years to more than 10m barrels a day - half the US's present demand. India's consumption is expected to rise by nearly 30% in the next five years.*

If world demand continues to grow at 2% a year, then almost 160m barrels a day will need to be extracted in 2035, twice as much as today. That, say most geologists is almost inconceivable. According to industry consultants IHS Energy, 90% of all known reserves are now in production, suggesting that few major discoveries remain to be made.

The article continues with a quote from Colin Campbell - *"All the major discoveries were in the 1960s, since when they have been declining gradually over time, give or take the occasional spike and trough," says Campbell. "The whole world has now been seismically searched and picked over. Geological knowledge has improved enormously in the past 30 years and it is almost inconceivable now that major fields remain to be found."*

The Lamp is a quarterly publication for ExxonMobil shareholders. In the first issue in 2003, the president of ExxonMobil Exploration Company, Jon Thompson, had this to say regarding future production requirements - *we estimate that world oil and gas production from existing fields is declining at an average rate of about 4 to 6 percent a year. To meet projected demand in 2015, the industry will have to add about 100 million oil-equivalent barrels a day of new production. That's equal to about 80 percent of today's production level. In other words, by 2015, we will need to find, develop and produce a volume of new oil and gas that is equal to eight out of every 10 barrels being produced today. In addition, the cost associated with providing this additional oil and gas is expected to be considerably more than what industry is now spending. Equally daunting is the fact that many of the most promising prospects are far from major markets — some in regions that lack even basic infrastructure. Others are in extreme climates, such as the Arctic, that present extraordinary technical challenges.* To appreciate the significance of these figures, if we in 2015 need 80 percent of 75 million barrels per day (as at 2003), as new production we must open new oilfields that can give 60 million barrels per day. The North Sea at the peak of its production was 6 million barrels per day. This means we would need to find 10 new regions of the size of the North Sea and develop them up to production by 2015.

In a subsequent report from ExxonMobil called 'A Report on Energy Trends, Greenhouse Gas Emissions and Alternative Energy', released in February 2004, it reaffirms these figures or 100 million barrels per day required by 2015, being 80% of current production. The report then states that the report 'World Energy Investment Outlook 2003', released by the International Energy Agency (IEA) has calculated a $530 billion per year total annual energy investment. *Of that, the IEA believes that about 40%, or $200 billion per year, will be required for oil and gas, primarily for exploration, development and production. To put this figure in perspective, $200 billion is larger than the GDP of Norway, whereas $530 billion is larger than the 2004 U.S. national defence budget.*

Australia's own oil production peaked in 2002. According to a report in the Energy Bulletin, Geoscience Australia and the Australian Bureau of Agricultural and Resource Economics (ABARE) estimate that - *Australian stocks of crude oil in the ground will be exhausted [by 2009] if the current rate of production is maintained and there is no new discovery of reserves.* The former managing director of Woodside Energy, John Ackhurst, who chaired the ABARE study, said in 2002 - *Australian liquid fuel self-sufficiency is expected to decline from an average of 80 to 90 per cent over the past decade to less than 40 per cent by 2010.*

On 29 April 2005, BHP reported in the Sydney Morning Herald that oil production out of Australia's oil production mainstay, the Bass Strait, dropped by 18 per cent in 2004 due to 'natural field depletion' or post-peak oil production rundown. This is a significantly fast drop in production from an oil reserve once peak production had been reached, and it has significant implications for the Australian economy. According to the Australian Petroleum Production and Exploration Association, on current trends in 10 years Australia will be producing only 280,000 barrels of oil per day while consuming around 1,030,000 barrels of oil per day. That will mean that we would be 78 per cent dependent on oil imports compared to only 30 per cent now. This will have very serious implications on our current accounts deficit.

6.3 ARE THERE ALTERNATIVES TO OIL?

For Western economies to continue in their current form, with a strong reliance on growth and development, we will need to find an alternative source of energy that is as cost effective, and as energy intensive, as oil. There is very little support, if any, for the likelihood that such an alternative exists. A good summary of the overall alternative fuel option is provided by Andrew McNamarra [2] - *We have coal for electric power for 200 years, but coal cannot effectively replace oil. While it is possible to make synthetic fuels from coal and while hydrogen extracted from coal can power a fuel cell, these processes use more energy than they produce. In other words, they are net energy losers. This is the unavoidable impact of the second law of thermodynamics. Nuclear power suffers from the same net energy loss problem, as well as the known radiation and waste storage risks.*
The only effective replacement energy source for oil is liquefied natural gas, but it is subject to the same Hubbert curve as oil and may even be disappearing at a faster rate. All other energy sources combined cannot replace the volume of energy we derive from oil. For some alternative energy sources, such as ethanol, far more energy is expended in planting, fertilising, growing, harvesting and processing than its end product renders. No other energy source can fly planes or drive heavy trucks and machinery. Further, most of the world's fertiliser is now made from natural gas, and most of the world's pesticide is made from oil. As fuel prices double and then double again in the years after the peak, we will be faced with some very hard choices in the fields of agriculture, food distribution and transport generally. The best prospect for an alternative energy source is from nuclear fusion, but the realisation of this technology has always been in the distant future and remains there today.

Oil is the most energy intense fuel readily available. It takes approximately 1 litre of oil to produce 20 litres of oil at the fuel bowser, ie. there is a 20:1 energy return on energy invested (EROEI). No other energy source that is currently available comes anywhere close to oil regarding EROEI.

The federal government has publicly expressed concerns regarding the viability of ethanol. In a letter from Nick Minchin, Minister for Finance and Administration, Deputy leader of the government in the Senate, published in the Age in May, the minister clearly states that they are not convinced that ethanol is an alternative worth pursuing. He writes - *The fact is, there is no current scientific evidence before the Australian government to suggest ethanol warrants even greater government support, such as mandating its use in fuel blends. The 2003 report into biofuels by eminent Australian research agencies (CSIRO and [ABARE]) could not be satisfied of the environmental benefits of the use of ethanol, and despite Baume's claims otherwise, the CSIRO has not been commissioned to revise their report.*

Further, other experts, such as David Pimentel of Cornell University, have found that the production of ethanol requires more energy than ethanol returns. Production technologies would need to increase at all stages of ethanol production for this fuel to be considered as a viable alternative.

In the article 'Ethanol's Potential: Looking Beyond Corn' by Danielle Murray from Earth Policy Institute, it describes other negative aspects of ethanol production. It states - *Although ethanol's popularity is growing, today's inefficient production methods and conversion technologies mean that this fuel will only produce modest environmental and economic benefits and could impinge on international food security. The largest obstacle to biofuel production is land availability. Expanding cropland for energy production will likely worsen the already intense competition for land between agriculture, forests, and urban sprawl. With temperatures rising and water tables falling worldwide, global food supply and demand are precariously balanced. World grain reserves are near all-time lows, and there is little idle cropland to be brought back into cultivation. Shifting food crops to fuel production could further tighten food supplies and raise prices, pitting affluent automobile owners against low-income food consumers.*

Although a significant proportion of the existing production of sugarcane in Australia can be converted from food to fuel production, the volume of ethanol produced would not significantly replace our oil requirements. And the food source provided by the sugarcane would still need to be replaced by another food source, so the loss in arable land would still be significant. The article continues - *with world energy demands rising, biofuels will meet only a fraction of fuel needs unless there are substantial improvements in vehicle fuel economy.*

Uranium as a fuel source also has significant problems. Besides the long lasting and extremely toxic waste created from fission reactions, the availability of uranium is also in question. The Ux Consulting Company publishes world nuclear fuel spot and term prices, and provides consulting services on the nuclear fuel cycle. On 9 March 2004 it released a statement on the availability of uranium which suggests that this resource may also be approaching a production peak due to increased demand. It states - *The decline in global commercial uranium inventories is rapidly shifting an inventory-driven market to one that is production-driven. Consolidation over the last several years has squeezed the number of uranium suppliers, reduced geographical diversity, and now several existing and future uranium production centres are in question. In the interim, long-term indicators are pointing toward a demand curve that will exceed supply within the next several years and ultimately lead to higher prices.* Uranium, as an energy source, also has a low EROEI ratio. When the energy involved in exploration, mining, transportation of the ore to reactors, commissioning and decommissioning of reactors, and the distribution of the energy from reactors to where it is used is considered, the EROEI is debatably close to 1:1, or less.

To use hydrogen as a fuel source it must be extracted from water. The energy required to create this hydrogen is greater than the energy released by burning the hydrogen. Using solar panels to electrolytically extract the hydrogen is considered to be the 'green' alternative to oil. However, this is a very energy expensive exercise. Solar cells produce electricity at about five times the cost of mains power (due to manufacturing costs). Electrolysis is about 60% efficient and the return of the hydrogen to electricity in a fuel cell is about 60% efficient. Then there is the compression of the hydrogen into tanks so that it can be used in vehicles.

This equates to at least 28 times the cost of running an electric car from batteries charged by mains power. It is debatable whether the overall EROEI is greater than 1:1.

There are other problems with hydrogen that are also resource based. The article 'Carmakers gear up for the next shortage' which appeared in the Financial Times (London, England), 6 July 2005, states - *Today's experimental hydrogen fuel cells use so much platinum that there is not enough of the precious metal to replace all the world's petrol engines. As Kazuo Okamoto, the new head of research and development at Toyota, Japan's biggest carmaker, says: "With the current type of technology we know already that (platinum supplies) will not be sufficient." And the problem cannot be solved by just digging up more of the metal in South Africa, which has the bulk of the world's reserves. At the current 60g or so of platinum in each fuel cell, the world's 780m cars and trucks would use 46,800 tons of the metal - just below the 47,570 tons estimated to be still in the ground. And this assumes each vehicle has only 100 horsepower, the same as the base diesel engine in a Volkswagen Golf hatchback. "There is no other alternative to hydrogen," Mr Okamoto says. "So one day (precious metals) will be a big big problem. That will be the barrier to hydrogen."* Because of our massive demand for energy today, any fuel alternative will likely be limited by resource restrictions at various parts of its consumption cycle.

As the EROEI of an alternative energy source gets down to levels approaching 1:1, it becomes vitally important that production efficiencies are kept at a maximum to ensure that is worthwhile producing the fuel at all. In an interview with Richard Heinberg (professor at the Santa Rosa branch of the New College of California where he teaches courses on Culture, Ecology, and Sustainable Community) published in Z Magazine, May 2004, he states - *Suppose we were to invest $100 billion dollars over the next ten years in making a transition to a hydrogen economy and then discovered that, in fact, hydrogen has a lot of hidden costs. Well, we can't afford to lose ten years and $100 billion dollars going down the wrong road at this point.* When we are faced with these EROEI's from the alternatives to oil as a fuel, it will force our economies to ensure far higher levels of efficiencies in the use of this fuel. Where oil has, in the past, been considered to be an almost free source of energy, alternative fuels (and the remaining oil), will be very precious.

John Anderson [3], hinted at the need to start evaluating an alternative now. His statements also indicate that the members of the federal government are also aware that there will be no simple transition to an alternative fuel that will enable our economy to function as it is now. He states - *While people talk about new technologies and they say as soon as oil reaches a certain price everybody will switch over to hydrogen and what have you. The reality is that it may not be as simple as that and you have to wonder whether over the next decade we won't start to get towards peak production and that could be a very interesting time and a very challenging time.* This is a strong statement issued from the top levels of Australian government. We need to seriously consider all aspects of energy depletion, how we are to replace oil as a fuel source, and/or how we are to transform our economy to exist with less oil.

6.4 THE NEED TO IMPROVE ENERGY EFFICIENCIES IN TRANSPORT

In regard to the future availability of a cheap fuel to provide our current modes of transport, of both people and freight, it becomes increasingly evident that expenditures that support the current modes, and on infrastructure for those modes, is very questionable. Ignoring the implications of Peak Oil can be viewed as a waste of the remaining cheap fuel we have, and the missing of a very important opportunity to use the remaining oil to convert our economy and transport industry into one that uses its fuels, and energy, far more efficiently. A brief description of the situation we are about to face, and the changes required is expressed by Andrew McNamarra [2] - *The challenges we face after peak oil will require localised food production and industry in a way not seen for 100 years. Local rail lines and fishing fleets will be vital to regional communities. Self-contained communities living close to work, farms, services and schools will not be merely desirable; they will be essential.*

On 8 February 2005, the US Department of Energy published a report analysing viable technologies to mitigate oil shortages associated with the upcoming peaking of world oil production. It studied 3 different scenarios - where a crash program of conversion occurred as the peak occurred, the same crash program started 10 years before the peak, and where the crash program started 20 years before the peak. It stated - *Improved fuel efficiency in the world's transportation sector will be a critical element in the long-term reduction of liquid fuel consumption, however, the scale of effort required will inherently take time and be very expensive...For the foreseeable future, electricity-producing technologies, eg., nuclear and solar energy, cannot substitute for liquid fuels in most transportation applications...No one has yet defined viable options for powering heavy trucks or airplanes with electricity.*

Typically, the 20-year option provided the least economic disruption. One of their recommendations states - *Government intervention will be essential, because the economic and social impacts of oil peaking will otherwise be chaotic, and crash program mitigation will need to be properly supported. How and when governments begin to seriously address these challenges is yet to be determined.*

This report is very relevant to the proposed highway upgrade. It clearly urges government policy to change from one of 'growth at all costs', to one where serious consideration of energy consumption is exercised, particularly with regard to transport. This sentiment was also expressed by Professor Tor Hundloe (Program Director, Environmental Management at University of Queensland) on the ABC's Queensland Stateline program on 24 June 2005. In the interview he said - *We're all saying the markets going to solve it, the market will solve it, prices of petrol go up, we'll find some alternative, it's not going to be like that unless we get a lot smarter and our governments get smarter and our investors get smarter.*

Matthew Simmons also confirms this need. In an interview with Jim Motavalli for emagazine.com, when asked whether a hydrogen economy could replace the current oil economy, he said that it couldn't and that it would need to be a far greater overhaul than simply replacing the fuel source. It would need to be a restructure of the industry, he states - *So it actually has to be a far more basic sort of overhaul. I think, for instance, that we have to get our freight business off the roads and back onto rail. That would be five to 10 times more energy efficient.*

The transport industry is one of the most significant consumers of oil and will therefore be the economy sector that will either be the one requiring the most significant structural changes, or suffer the greatest economic upheaval, depending on how we plan for it. Of the 30 nations of the OECD, in 1973, transportation accounted for 42% of oil consumed, growing to 58% of consumption by 2004. During both World Wars, and in the 1970s energy crisis, the industry suffered significant rationing, providing us with a historical precedent for the situation that will soon affect us.

In the article by Yves Cochet [7] he states that the first to be effected will be aviation and intensive agriculture (fertilisers and farm machinery). He continues - *This will occur unless stabilising policies are used -- for a time and in some other sectors -- to lower taxes on oil as prices rise. But afterwards ground transport, tourism, the petrochemical industry, and the automotive industry will feel the depressive effects of a reduction in the quantity of oil (depletion). To what extent will this situation lead to a general recession? No one knows, but the blindness of politicians and the usual panicked over-reaction of markets allows us to fear the worst.* This clearly indicates that changes need to be made to our current modes of transportation, and to modify our dependence on transportation to effectively reduce this economic sector's consumption of oil.

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7.0 RAIL TRANSPORT

MICHAEL NAMRELL B Educ.

7.1 INTRODUCTION

In view of the peak oil argument presented above, it becomes clear that there is an urgent need for a more responsible approach to cater for Australia's future transport needs than further encouragement of road based transport. Studies produced in Australia as well as in the United States and Europe all clearly indicates that the most effective mode to transport goods in terms of energy efficiency, economy and environmental impacts is rail transport. Despite this there is a clear lack of investment into rail transport and infrastructure when compared to investment in road infrastructure.

There is a difficulty in comparing the different modes of transport in as much as road transport is essentially a highly subsidised type of transport. In the US about $200 million is spent on building and rebuilding roads every single day. The actual cost of building a freeway can be as high as $1 billion per kilometre (when the cost of all externalities are taken into account), while new light rail costs only $10 to $16 million per kilometre (about one or one-and-a-half per cent of the cost). It has been estimated that the US spends $300 billion a year to subsidize roads and road based transport. These costs do not even include any of the ecological destruction caused by road transport. It is safe to assume that comparable figures are true for construction and maintenance of highways and freeways in Australia.

Railway construction is less capital intensive but more labour intensive, creating many more jobs than road building. Railways use less fossil fuels and produce less pollution both in construction and use, and they are much more efficient.
In Australia, the National Rail Corporation has outlined some of the advantages rail has over road based transport. In a submission to the Fuel Taxation Inquiry, NRC noted:

"*Rail offers significant economic, environmental and social benefits over road transport. Rail freight transport is over two and a half times more fuel efficient per net tonne-km.*

The transportation of freight by road is estimated to produce over three times the greenhouse gas emissions of transportation by rail. Rail emissions have decreased 9% since 1990, despite an increasing freight and passenger task. A 1991 Australian Standing Committee on Industry, Science and Technology found that increased use of rail could result in ".. significant reductions in carbon dioxide emissions and large savings in Australian consumption of liquid fuels for transport services..."

Road transport accidents are estimated to contribute 92% of the total costs associated with transport accidents in Australia, as compared with rail accidents which are estimated to contribute just 1%. Rail transport is over 30 times safer per tonne of freight hauled.

In addition the road freight industry is a significant contributor to noise and visual pollution on city and regional roads.

The Australian Bureau of Transport Economics has estimated that upgrading Australia's intercapital mainline rail infrastructure could result in a 40% shift of intercapital freight from road to rail and generate net social benefits of $3.4b by 2015. However the potential for such a modal shift is constrained by current fuel taxation and infrastructure funding policies."(National Rail Corporation Submission to Fuel Taxation Inquiry Committee, 1 November 2001)

In Europe, the views on the efficiency of rail in comparison to road transport are very similar. The European Environment Agency points out that:

"Trucks are by far the least energy-efficient mode of freight transport (airfreight transport is probably less energy-efficient, but no data exists) Rail and shipping are much more energy efficient, emphasizing the importance of the Community's strategy to promote shipping and intermodal freight transport."(Energy efficiency and specific CO2 emissions, Report by the European Environment Agency, Version 20/08/2001)

The reasons for choosing a road based transport system are by no means based on economics, they are strictly political. For any substantial change to take place, a complete paradigm shift is required. Peak oil might be the catalyst that is needed for this shift to take place. The following is an attempt to outline some of the possibilities and benefits of rail transport in a time of peaking oil production and rising fuel prices.

7.2 INTERMODALITY

The best way to ensure the economic viability in rail transport is to encourage a serious, long term transport strategy that focuses on intermodality**.** A strategy like that would ensure best use of all available transport modes including rail, road, shipping and air.
Several reports have been written on the advantages and the effectiveness of intermodality. A number of companies around the world and in Australia have developed various systems in order to make the crucial transition between the different modes as efficient as possible.

Rail development is at a very interesting stage when a range of technologies are being considered in order to facilitate a seamless transition between the different modes of transportation, but also in order to make rail transport economically viable over shorter distances than ever before.
"*Railways are at a crucial point in their development, not only in Europe, but on almost every continent. Never has demand been as strong as now for reliable, high-performance, rail transport systems, capable of handling volumes of traffic not seen in the past.*
This holds true whether it involves moving people between business centres, or on their daily journeys through high-density population areas, as well as for the transport of railfreight nationally and internationally. In addition, with the exception of railways and public transport in general, no other mode in existence today, be it road, air or waterways, is able to offer major increases in capacity without generating very heavy costs. Above all, rail transport is less harmful to the environment; which is more and more of an issue for society in general. Rail transport has a double advantage. On one hand, railways have shown indisputable proof of the efficiency of their system--and its optimisation--in the amount of energy consumed, transport performance and capacity, operational costs, and very low impact on the environment. On the other hand, railways are the only means of transport with a considerable potential for improvement, through perfecting standard rail methods and combining them with a whole series of new technologies."(*International Railway Journal , April 2003*)

There is also support for an integrated approach to our transport system from AAA (Australian Automobile Association). In a submission to an inquiry by the Productivity Commission in 1999, the AAA stated *"The integration of road, rail, maritime, aviation and public transport infrastructure, together with modal interchanges, is important if each mode is to maximise its technological capability in a multi-modal transport system which provides a seamless service to customers.*

The efficiency of the transport system will only be maximised through an approach which allows the specialised benefits offered by particular modes to be realised. Transport policy should seek to promote an environment which provides for all modes to be used freely in the optimal combination for the movement of people and freight without restriction or distortion of choice".

An integrated approach to transport is important because investments in one mode will affect the freight mode choice. The Allen Consulting Group's study about the contribution of investment in land infrastructure to the Australian economy, commissioned by the AAA in 1993, found that road investment leads to a substitution away from other forms of transport, in favour of road transport and largely at the expense of rail transport (AAA/Allen Consulting Group, 1993, p 72).(Progress in Rail Reform, an inquiry by the Productivity Commission, 1999)

In the study, "*Energy saving in transport of goods - a pilot project in rural natural resource based industries"* carried out in 2001 in the Nordic countries of Norway, Sweden and Finland, the following points are made about rail transport and intermodality in the European case:

"According to a Finnish study, one kilometre transport of 40 tonnes would cause the following energy consumption figures (Transpress 2/98):

- *0,69 kWh for an electricity goods train*
- *2,27 kWh for a diesel goods train and*
- *4,98 kWh for a lorry transport.*

Transfer of goods to rail and ship transport would, according to this, thus decrease the energy use. Decreasing the road transport volumes is one the main objectives of EU transport policy. Congestion and environmental effects of road transport are the main reasons for that. The working paper by European Commission (July 1998) on environmental problems connected with lorry transport suggests the following points, among others, to attack the problem:

- *Increase the use of combined transport by relating the transport charges more closely to actual road use as well as greater flexibility on weights. In practice this means reduction of vehicle taxes and road user charges and increasing maximum weight of vehicle combination from 40 to 44 tonnes. The current legislation does not take into account that combined transport loads may be heavier. Also, the combined transport should be exempted from weekend, night and holiday transport restrictions.*
- *Burdens caused by road vehicles are minimised. Improved technical standards are tools for this.*

- *Environmentally friendly modes of transport (rail, inland waterways and short sea shipping) are made commercially more attractive. This may be done by making them more competitive (improvements to infrastructure, logistics, door-to-door service and reliability), providing a level of playing field (e.g. improved enforcement of the rules on driving time) and by improving combined and intermodal transport especially by making them more attractive over short distances.*

The European Commission states in its COM(97) 243 document "Intermodality and intermodal goods transport in the European Union" that

"An efficient transport system is a prerequisite for the European Union's competitiveness. With the projected growth of international trade, the possible extension of the Union to the Central Europe and enhanced co-operation with the Mediterranean countries, the role of transport will become more important. " Furthermore, the report states "in order to achieve socio-economic and environmental sustainability, the efficient and balanced use of existing capacities throughout the European transport system becomes a key challenge.

Intermodality is a quality indicator of the level of integration between the different transport modes: more intermodality means more integration and complementarity between modes, which provides scope for more efficient use of the transport system. The integration between modes needs to take place at the levels of infrastructure and other hardware (e.g. loading units, vehicles, communications), operations and services, as well as regulatory conditions."(R 4/2001: Energy saving in transport of goods - a pilot project in rural natural resource based industries).

This call for a new way of thinking in terms of transport has been echoed from other countries, in particular from within the European Union. One program that is dealing with this is the FLIHTT cooperative project. It is developed by the Costamasnaga Group in Italy, European leader in the production of intermodal equipment and wagons. In 1996, they commenced a study of the European applicability of TRAI-2000, the "laboratory" of the horizontal transhipment system developed and produced by Costamasnaga for the Italian Ministry of Trade, Industry and Innovation.

The TRAI system, patented several years ago, consists of a modular tray on which the freight units - pallets, containers, crates, etc. - are placed, ready for automatic sliding into a goods wagon, for example, or mechanical sliding from one system of transport to another, such as at the docks. The original feature of this system is that the sliding is at the head of the wagon. This is sometimes seen as a weak point, the convoy having to be divided up into separate wagon trains on one or more platforms. The disadvantage, if there is one, remains minor compared with the benefits confirmed by the European technico-economic feasibility study.

The FLIHTT system seems to be particularly favourable in terms of:
- Low energetic costs linked to the horizontal transshipment of load units; - High safety parameters;
- Low level of infrastructural investment costs due to the small areas required;
- Low technological investment costs linked to the simplicity of horizontal transshipment cycle,
- Saving on management costs due to highly automated operations between different modes involved.
- Global energy savings due to the above points.

Intermodal transport systems in the past have been regarded as economically competitive over distances of 500 kilometers and over. With the FLIHTT system, this distance is halved. *"In general, intermodal transport becomes competitive over distances of more than 500 kilometres. But even if we include the costs of technical changes, our system can be efficient for journeys of under 200 kilometres, which means the majority of goods transport between border regions and European towns." (Fabio Magni, Managing Director Costamasnaga Group).*

The research studies further confirm as technically feasible the concept of fixing standard and non standard load units on a specific tray in order to make the system horizontal (therefore independent) but at the same time compatible with the vertical systems currently adopted in the terminals. The economic analysis which compared the investment and operational costs of the horizontal solution proved the benefits that can be obtained, compared to the conventional systems.

Moreover, the proposed horizontal system is still competitive even including the costs of modifications to the rail wagons and the adoption of the tray. Modifications needed to make the horizontal system compatible with the vertical, but not mandatory if adopted in a self sustaining environment (road/rail/road bypassing the conventional terminals and factory handled loading/unloading operations).

The horizontal system can therefore be technically feasible and economically self-sustainable when adopted by an intermodal operator. In fact minor modifications to the rail wagons and the adoption of the tray make the horizontal system effective but still operational on the vertical system, allowing the operators to approach different (and presently competing) markets.

Due to its specificity (automation and low costs) the horizontal system can provide benefits also on short distances (below 200 Km.) becoming attractive to "door to door" distributors and to operators presently adopting only the road modality. The proposed system can therefore be a positive solution for the interurban distribution of goods, representing a viable and cost effective alternative to the road modality.

There are also Australian examples such Adelaide company Air-Ride who introduced an innovative road-n-rail trailer coupling system whereby the trailers can be coupled to both semi-trailers and rail wagons (road-n-rail) without the need for the goods to be unloaded and reloaded. A $2.1 million R&D Start grant through the Commonwealth Government's business unit, AusIndustry, supported the research and development project.

Previously, similar road-n-rail technology had to be sourced from the United States. Bi-Modal freight involves turning semi-trailers into trains by backing the trucks onto the train bogey. An air suspension system then lifts the wheels so that the semi-trailer becomes a carriage.

Air-Ride has developed a concept for new road-n-rail technology and has been asked by the National Rail Corporation to tender for the design, and develop and supply the new road and rail trailer coupling system. Recently Air-Ride was awarded a further $2 million R&D Start grant to embark on the development of Polycom freight vans which are up to 30 percent lighter than anything similar in the world.

7.4 ENERGY EFFICIENCY IN RAIL TRANSPORT

In the movement of domestic freight, ancillary rail and coastal shipping continue to be the most energy efficient modes followed by hire and reward rail, articulated trucks, pipelines and rigid trucks (Apelbaum Consulting Group, 2004).
The recent increase in fuel prices has in a small way demonstrated what we have to look forward to in terms of cost for oil driven, road based transport. A pilot study undertaken in Sweden, Norway and Finland as part of a research program within the European Union has resulted in some telling conclusions. The study focused on different types of goods from frozen fish in Norway to paper in Finland. In terms of energy efficiency the study points out the following:

"*If all the fish export from Norway to the European continent where transported by train the total reduction in energy use could be about 70.000 ton fuel or nearly 700 mill kWh. This calculation is based on the assumption that our four cases give a representative picture of transport distance and transport mode in the today fish export. This is not necessarily right, but our calculation gives an estimate of the future energy saving potential.*

A comparison between the actual cases with lorry transport in 1999 and the alternatives: rail transport, boat transport and ferry and rail based transport is shown in Table 51.

Table 51. The energy use (Kwh) for the cases of fish transport. Round trips. Percentage change compared with lorry transport in parenthesis. Actions implemented during the project are hatched

Main transport mode/case	**A**	**B**	**C**	**D**
Lorry based transport (1999)	20959	27341	12975	21145
Rail based transport	4918 (-77 %)	10894 (-60 %)	3891 (-70%)	
Boat based transport		23463 (-14%)	3456 (-73%)	4488 (-79%)
Ferry and rail transport				16802 (-21%)

Fig. 1

During the project period transferral from road to rail and ferry were done for two of the four case routes. Rail based transport with dried cod to Italy reach a reduction in energy use at 60 % compared with lorry based transport. The effect comes from the more energy efficiency train transport used on the whole distance from Western Norway to Verona in Italy. The transport is similar in time efficiency (5% difference) to the lorry-based transport in 1999.

In Finland the energy use in the case company UPM-Kymmene Group and their transport chain, from Voikkaa paper mill to the customer in Cologne, Germany is analysed. The energy use is calculated for transporting 8800 tonnes paper. The amount of raw materials is estimated from their yearly volumes in proportion to yearly production of paper. The energy use includes loading, unloading and other handling of goods except for the possible handling in Germany, which differs from the handling in Finland. The total energy use of the transport chain amounts to 2971 MWh, which is 0,34 MWh per paper tonne. From the energy efficiency, kWh/tonne-km, it is evident that the train transport in Germany is more energy efficient than the train transport in Finland. This is probably due to the fact that transport distances in this case are shorter in Finland than selected distance in Germany."(R 4/2001: Energy saving in transport of goods - a pilot project in rural natural resource based industries).

In the report "*Comparison of Greenhouse Gas Emissions by Australian Intermodal and Road Transport" (2002)*, energy consumption by different modes of transport along some Australian freight corridors is compared. It is clear from Fig.2 below, that in every case regardless of distance; intermodal transport (including Pick-up and Delivery) is outperforming other modes of transport.

Figure 6 Energy consumed by equivalent freight tasks carried by intermodal and direct road transport (million megajoules)

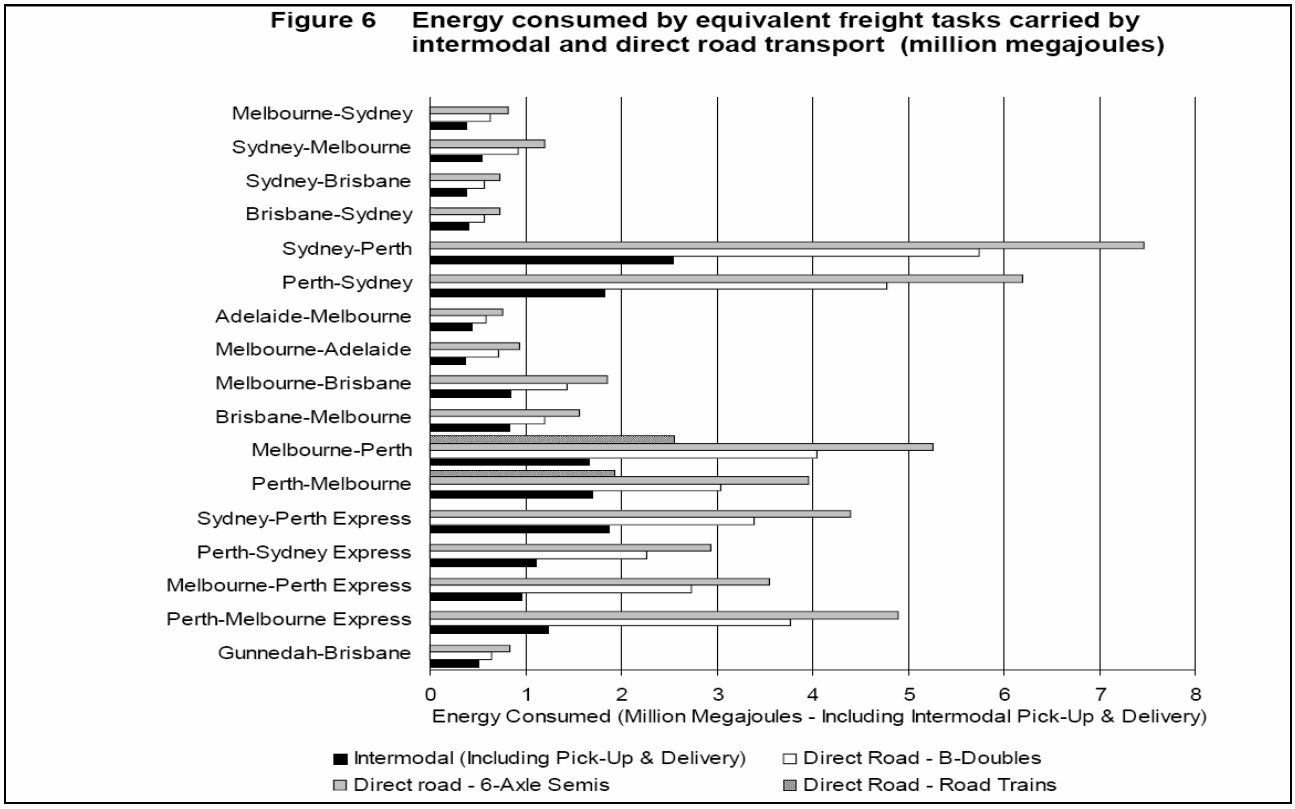

Fig.2

Studies undertaken in North America are indicating that further improvements in rail transport efficiency are possible. The Canadian freight rail mode has made significant improvements in energy intensity since 1990. Intensity declined from 0.34 to 0.22 megajoules per tonne-kilometre, or 35 percent, between 1990 and 2003. However, opportunities exist to reduce energy consumption even further.

New technologies such as hybrid-electric locomotives, which would reduce energy consumption and related Greenhouse gas emissions, may have practical applications in rail. A locomotive typically has eight notches (throttle settings such as gears or speeds). Specific notches are suitable for specific tasks. For example, when hauling goods from point A to B, a train requires speed, so it operates in higher notches. In the switching yards, however, where trains are assembled (cars attached to a locomotive) and railway cars are moved from one track to another, a locomotive will spend about 95 percent of its duty cycle idling or in notches one, two or three. Hybrid locomotive technology is well suited to stop-and-go conditions in rail yards. The engine does not idle and is more efficient than a diesel engine when a locomotive is operating in lower notches *("Influence of Duty Cycles and Fleet Profile on Emissions from Locomotives in Canada," prepared for Transport Canada's Transportation Development Centre, June 2002).*

7.5 GREENHOUSE GAS EMISSIONS

Australia ranks sixteenth among major greenhouse gas producing nations, but has the third highest greenhouse gas emissions from transport per capita in the world. It is higher than the OECD average. Even with the government’s refusal to ratify the Kyoto agreement, Australia's commitment to the 1997 Kyoto Protocol on greenhouse gas emissions requires its emissions to be no more than 8% above its 1990 levels by 2012. However, according to the Australian Greenhouse Office (1998), Australia's greenhouse gas emissions are now 17% above 1990 levels.

Transport contributes 16% of Australia's total greenhouse gas emissions, an increase of 18% over 1990 levels. Transport is one of the fastest growing sectors of greenhouse gas emissions. This is because of Australia's excessive reliance on road transport. Australia has the highest volume of road freight carried per capita in the world and over 90% of urban passenger travel is by car. The Bureau of Transport Economics predicts that greenhouse gas emissions from transport will have increased nearly 50% between 1990 and 2015, with emissions from road transport increasing 45%.

Road transport causes 14% of total greenhouse gas emissions and 89% of the nation's transport greenhouse gas emissions. In contrast, rail causes just 0.4% of total emissions and only 2% of transport emissions, a decrease of 9% over its 1990 level.

Rail transport can play a major role in reducing Australia's transport greenhouse gas emissions. One freight train between Melbourne and Sydney replaces 150 semi-trailers and saves 45,000 litres of fuel and 130 tonnes of greenhouse gases compared with road haulage. Just 10 additional trains each day each way between Sydney and Melbourne would remove the entire 3,200 daily truck movements off the highway, saving 1 million tonnes of greenhouse gases per annum.

This has also been confirmed in Europe where, according to a study commissioned by industry lobby UIRR, doubling the use of combined road-rail transport of freight in Europe within ten years could cut freight transport carbon dioxide (CO2) emissions by 40% or more,. The doubling target was an aspiration in the 2000 EU transport white paper.

The UIRR group is using the study to promote a shift of more freight from road to rail - a key element in increasing use of combined transport and "an important instrument" in reducing CO2 emissions. Using combined transport instead of road alone currently results in a reduction of 1.8m tonnes of CO2 a year, it claims. Road and rail routes were compared for 20 key European freight journeys. According to the results, putting freight on rail would cut CO2 by 55% on average compared with road transport only.

In the UK, carbon dioxide emissions from road hauliers increased by more than a third between 1990 and 2002. Road freight now accounts for 8% of UK carbon dioxide emissions (*Sustainable Development Indicators DEFRA, 2005).* Rail overall produces less than 1% of the total UK emissions of carbon dioxide compared to 21% from road transport. (Railway *Forum, 2005).*Overall, studies discussed by Network Rail, UK suggest that rail transport generates between 10% and 20% of the level of road transport emissions.

The advantages of rail over road for long distance freight haulage are also demonstrated by Specialized Container Transport, a logistics company operating general freight trains between Melbourne and Perth. In the company's first two years of operation from June 1995, it carried over 300,000 tonnes of freight by rail between Melbourne and Perth, saving 15,000 semi-trailer movements and 100 million litres of fuel compared with road haulage.

The Bureau of Transport and Regional Economics estimates that upgrading inter-capital mainline rail infrastructure could result in a 40% shift of inter-capital freight from road to rail, generating net social benefits of $3,400 million by 2015. Transferring this amount of freight from road to rail in the Melbourne - Sydney -Brisbane corridor would save approximately 200 million litres of fuel and 580,000 tonnes of greenhouse gases annually.

Rail is still twice as energy efficient as road even after fuel use has been included for rail line haul, road pick up and delivery from rail terminals, manufacture of transport equipment and construction of roads and railway lines.

Australia's domestic freight task is expected to double by 2020. In the same period, fuel consumption by articulated trucks is forecast to increase by at least 70% and greenhouse gas emissions from articulated trucks are forecast to increase by at least 75%.

Back in 1991, the Senate Standing Committee on Industry, Science and Technology found that rail freight services could help Australia achieve large savings in fuel consumption and carbon dioxide emissions. Yet today there are still evidence of an indecisive government, a lack of a uniform transport policy and the constant problem between state and federal levels of government. With Peak Oil a very real issue within a few years, it would seem an appropriate time to again start reviewing some of the alternatives to a continued and in fact increased reliance on road transport for goods and passengers. Increased use of rail to absorb the growth in passenger and freight demand over the next 20 years will reduce Australia's transport energy consumption, reducing the forecast increases in road transport greenhouse gas emissions.

In the report "*Comparison of Greenhouse Gas Emissions by Australian Intermodal and Road Transport" (2002)* commissioned by Queensland Rail Network Access, a comprehensive comparison of greenhouse gas emissions between road transport and intermodal transport on 9 different transport routes is made. The main transport corridors include Sydney-Brisbane, Melbourne-Sydney, Sydney-Perth etc. The results are very clearly in favour of intermodal transportation. In all cases, The CO2 emissions were considerable higher for road transport, for all types of trucks. The emissions from intermodal transport were 31%- 54% less than 6-axle B-doubles and 41%-70% less than 9 Axle B-doubles.

Very similar conclusions can be made from recent studies undertaken in Europe. The European report *"*Comparative *Analysis of Energy Consumption and CO2 Emissions of Road Transport and Combined Transport Road /Rail" (2002)* was commissioned by the International Road Transport Union and logistics providers association Bundesverband Guterkraftverkehr Logistik und Entsorgung.

The results in the report indicate that energy consumption for combined transport was lower on 16 out of 19 studied routes. It also showed that CO2 emissions for combined transport were lower on 17 out of 19 studied routes (Fig.3). According to this study it was also clear that in a number of aspects, combined transport outperformed road transport.

Figure 4.2 CO_2 emissions: Combined transport compared with road transport

Source: IRU/BGL (2002), p 4.

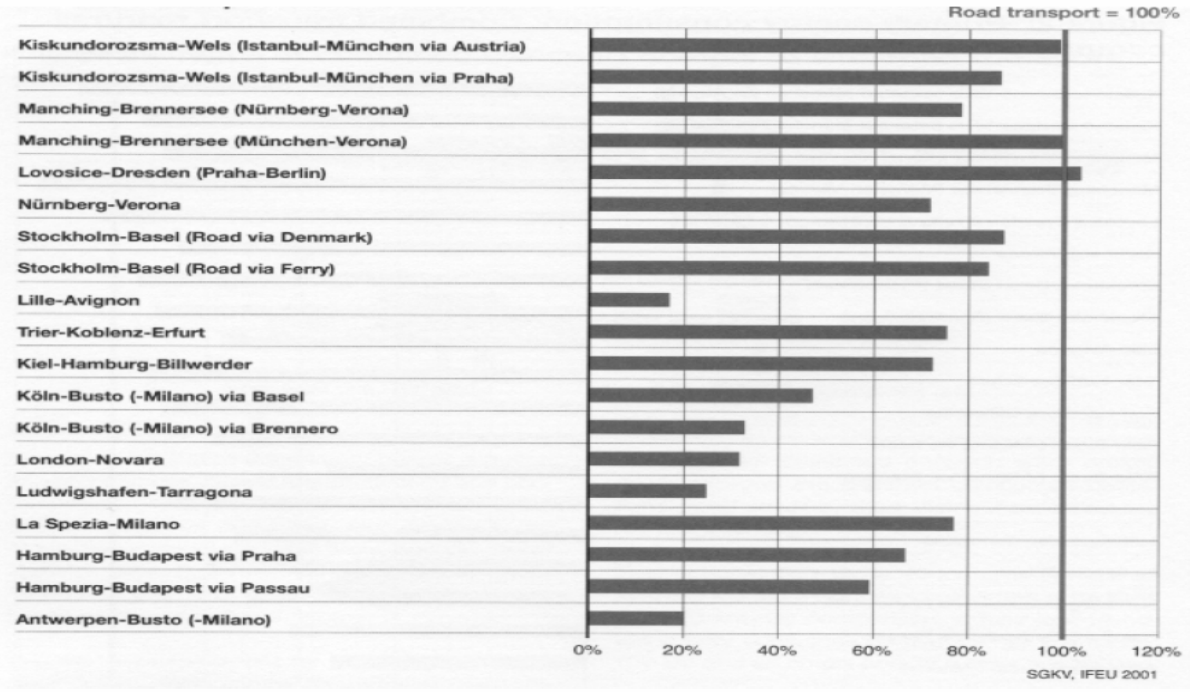

Fig.3

7.6 COMPETITIVE NEUTRALITY BETWEEN ROAD AND RAIL TRANSPORT

It is clear that the types of charges and taxations that are implemented will affect the competitive neutrality between different transport modes. In the case of road and rail transport in Australia there is a definite distortion in the competitiveness between the two modes that favours road transport. In a research paper from 2000 titled "Cost Recovery in Road and Rail Transport", Richard Webb from the Economics, Commerce and Industrial Relations Group states: "*Governments levy charges on all modes to recover the cost of providing infrastructure and other resources used in transport services, and impose taxes to raise revenue, change the allocation of resources and for equity reasons. Charges and taxes affect prices of each mode and hence their relative competitiveness. If not levied efficiently, charges and taxes can distort use towards a particular mode, and so reduce the economic efficiency of the transport system as a whole. Ultimately, national productivity can be impaired."*

When estimating actual cost for various modes of transport it is often difficult to estimate the full cost of the externalities such as social and ecological costs. It is, however, imperative that this is taken in to account since the cost is very real and is measured in billions of dollars annually. Economic theory suggests that users should pay for the cost of negative externalities such as noise, air pollution, congestion and accidents. Obviously, another cost that should be carried in full by the user is the wear and tear of road surfaces as well as the increased cost for road and bridge construction in order to accommodate heavier freight.

"*As noted, efficient charging requires that users bear the full cost to society of resource use including damage to roads and externalities. Heavy trucks account for most damage to roads and the amount of damage is related to vehicle weight, distance travelled, number of axles and the strength and thickness of the pavement. Charges for road damage should, therefore, be based on these factors."(Cost Recovery in Road and Rail Transport, 2000).* Studies from the Highways Agency in the UK has pointed out that "*A 40 tonne, 5 axle lorry causes over 10,000 times more damage to road surfaces than an average car."(Design Manual for Roads and Bridges, Highways Agency, 1994).*

If this cost is not carried by the user we have in effect a subsidy that will contribute to the distorted competitiveness between different modes of transport. According to Webb, when controlling for mass and distance, rail access charges greatly exceed road user charges. In fact, "*the total social cost of transport externalities is considerable. Moreover, the cost of road externalities is in the order of seven times the cost of rail externalities for interstate non-bulk freight transport."(Cost Recovery in Road and Rail Transport, 2000).* Research in the UK has found that heavy goods vehicles only pay for around 59% - 69% of the full (including the social and environmental) costs they impose upon society. These costs include greenhouse gas emissions, air pollution, noise, congestion, accidents and deaths (*Environmental and Social Costs of Heavy Goods Vehicles and Options for Reforming the Fiscal System, Oxford Economic Research Associates, report prepared for English Welsh and Scottish Railway, January 1999).*

One way to alleviate this is to impose charges on heavy vehicles that more fully reflect the cost of their use of roads, and to ensure that both rail and road face the full cost of externalities, with road in particular having to pay more.

It must also be pointed out that an adjustment of taxes and charges for users would only correct the distortion to a degree. There is also a compelling argument that a lack of spending on infrastructure is effectively an obstacle for rail to gain an equal standing in the transport market. "*Finally it should be remembered that taxes and charges are only one aspect of government policies affecting competitive neutrality between rail and road transport. Other areas are infrastructure investment arrangements, access regimes, safety regulation and operating procedures and standards. Indeed, some of these areas, particularly infrastructure funding and investment arrangements, may be more important than charges and taxes in trying to attain competitive neutrality. Competitive neutrality of charges and taxes alone would, therefore, still not resolve the issue of whether government policies advantage or disadvantage one mode relative to the other."(Cost Recovery in Road and Rail Transport, 2000).*

If this is implemented in full, then road transport, in particular B-doubles, will not be seen as such an attractive transport alternative. It is only due to the heavy subsidies that are granted through a lack of competitive neutrality between road and rail transport that road transport is being regarded as even a viable alternative.

8.0 CONCLUSIONS

This submission has identified substantial flaws within the project assessments undertaken in the Woodburn to Ballina Pacific Highway Upgrade Project. Several of these flaws are of such serious concern that taxpayer's resources will be expended in a highly inefficient and ineffective fashion.

The concerns over the social, economic and environmental impacts of Route 2C of the Woodburn to Ballina Upgrade, which at time of preparation of this submission was favoured by the RTA, are of such magnitude that this route must not be built.

Route 2C contains areas of national environmental significance, extensive areas of seven Endangered Ecological Communities as well as the largest areas of old growth vegetation in the Lower Richmond Valley. Furthermore the largest populations in NSW of a host of threatened species occur within Option 2C.

The RTA, Hyder Consultants and Coffey Geosciences have not undertaken an objective and rigorous assessment of the geomorphology and hydrogeology of the Woodburn to Ballina study area. Extensive wetland areas, major peat deposits and large groundwater reserves remain completely unassessed and unidentified in project documentation. These areas are the least suitable landscapes for constructing an upgrade of the Pacific Highway between Woodburn and Ballina.

The adverse impacts upon the amenity and social fabric from constructing a six lane highway through the communities of Laws Point, Bagotville, Meerschaum Vale, Meridian Heights and Coolgardie are so great that Route 2C must not be built. Furthermore with the demonstrated pollution risk and high extent of acoustic impact, the construction of this route will have massive detrimental impacts upon communities presently unaffected. Impacts upon the economies of these areas through construction of Route 2C are great, with a diverse range of economic pursuits occurring, the loss of economic viability in various industries will occur.

This submission concludes that an upgrade of the Pacific Highway between Woodburn and Ballina must be constructed along the existing alignment, so as to limit environmental, social and economic impacts. Option 2F is the closest to the existing highway alignment, and if the RTA is not prepared to upgrade the existing route, then Option 2F must be the route adopted in order to limit social, environmental and economic costs to the local, state and national communities.

The Blackwall Highway Action Group is highly supportive of the use of rail for bulk freight transport and the reduction in greenhouse gas emissions that will occur in using this more efficient means of travel. With demonstrated shortages of oil occurring, oil prices climbing sharply and the impacts from an enhanced greenhouse effect becoming ever more apparent, to construct an upgrade of the Woodburn to Ballina section of the Pacific Highway that is approximately 1.5km longer (Route 2C) than the existing highway is nonsensical.