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Sectoral guidelines for Environmental Reports — Major Roads

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1 INTRODUCTION

1.1 Scope of guidelines

Roads form a primary link for the movement of people and goods in Pakistan. Major roads are taken here to include motor ways, major rural roads and major urban arterial roads. Ancillary facilities such as all works within the right of way, restoration of access to surrounding property, traffic control devices, administration buildings, tollbooths, truck weighing facilities, rest and service areas, borrow pits, maintenance depots and construction compounds are also included within the scope of the guideline.

Minor works such as the maintenance, repair and improvement of existing roads, and the construction of small lengths of new roads of limited capacity, are not included within the scope of this guideline. Roads of intermediate scale, and the rehabilitation (including sealing) of major routes may require the preparation of an Environmental Report, where the impacts are likely to be significant, and as required by the Responsible Authority.

The guidelines will assist proponents to identify the key environmental issues that need to be addressed as well as mitigation measures and alternatives that should be considered. Readers are advised not to apply a mechanistic approach based on these guidelines. No technique can replace the thoughtful consideration of the proposal, its siting and the physical and cultural environment in which it is proposed.

The environmental issues discussed in the guidelines are not exhaustive, and the degree of relevance will vary from proposal to proposal. The Environmental Report for a specific road proposal should only deal with those issues relevant to the particular proposal and focus on the key issues.

1.2 Context of guidelines

This guideline is part of a package of regulations and guidelines which includes:

- The Pakistan Environmental Ordinance 1997
- Policy and procedures for filing, review and approval of environmental assessments
- Guidelines for the preparation and review of Environmental Reports
- Guidelines for public participation
- Guidelines for sensitive and critical areas
- Pakistan environmental legislation and the National Environmental Quality Standards (NEQS)
- Sectoral guidelines for Environmental Reports: ***Major Roads***

This guideline should not be read on its own, but in the context of the overall package.

2 SECTOR OVERVIEW

2.1 Potential environmental impacts

Socio-economic benefits provided by road and highway projects include all-weather reliability, reduced transportation costs, increased access to markets for local produce and products, access to new employment centres, employment of local workers on the project itself, better access to health care and other social services, and strengthening of local economies. The impacts of improvement, rehabilitation and maintenance projects, although

usually more limited, can still be significant, not only on natural resources and systems but also on the social and cultural environment.

Direct impacts of road and highway projects result from construction, maintenance and traffic use. The most significant construction impacts are those related to clearing, grading or roadbed construction; loss of vegetation cover; foreclosure of other land uses; modification of natural drainage patterns; changes in groundwater elevation; landslides, erosion, stream and lake sedimentation; degradation of vistas or destruction of cultural sites; and interference with movements of wildlife, livestock and local residents. Many of these impacts can arise not only at the construction site but also at quarries, borrow pits and material storage areas serving the project. In addition, adverse environmental and socio-cultural impacts can occur in both construction and maintenance projects as a result of air and soil pollution from asphalt plants, dust, noise from construction equipment and blasting; use of pesticides; fuel and oil spills; trash and garbage; and, on large projects, the presence of non-resident labour force.

Direct road and highway use impacts may include: increased demand for motor fuels; accidents; displacement of non-motorised methods of transport; increased air pollution, noise, and roadside litter; injury or death to animals and people attempting to cross roadways; health risk and environmental damage from accidents involving hazardous materials in transit; and water pollution from spills or accumulated contaminants on road surfaces.

A wide variety of indirect negative impacts can result from road and highway construction, including disruption of local land ownership by speculation; impacts of land development induced by the project; greater human access to wildlands, forests and other natural areas; health impacts resulting from changed drainage patterns and the potential of the road to act as a vector for the spread of disease; and labour force migration and displacement of subsistence economies.

2.2 Road siting

There are no alternatives to roads that fulfill the functions of providing relatively fast, cheap land transportation. Air, rail and water transport are more likely to complement than to substitute for roads and highways. Alternatives to the construction of new roads or expansion of old ones which deserve consideration in transportation planning from an environmental point of view include improvements in traffic management and public transportation on existing roads, rail systems for freight or passengers, and increased investment in non-motorised transportation for short distances.

Alternatives which should be investigated in planning and designing an individual project include alignments to avoid valuable or sensitive resources and alignments that do not provide access to wildlands or other areas which should remain in their natural state.

Siting of a road is the most critical decision in road construction. It will largely determine the type and magnitude of environmental and social impacts that will result from road construction. Alignments through lands of indigenous peoples, critical wildlands and wildlife habitat, lands unsuited to probable land use changes that will occur by both planned and unplanned development stimulated by the road, and locations where there are potential natural hazards should be avoided. Decisions on road siting frequently involve rapid screening and appraisal of many proposed locations and road specifications, and should involve a wide range of line agencies and levels of organisation. Siting involves the collection of data on the climate, soil, geology, hydrology, biology/ecology, and social factors (land and resource use patterns, local economy, class and economic structure, local administrative or power structures) of the sites proposed for construction. Remote sensing information sources and qualified interpreters are particularly useful for these functions.

Table 1. Matters to be considered in initial site assessment

Operational requirements	• If this is a new road reserve, is the corridor location consistent with any strategic transport plan for the area? • Does the site or corridor provide sufficient land area for present and future requirements? • Is the site efficient in relation to extractive material and other building material sources? • Are the rainfall patterns or prevailing wind directions likely to cause management problems?
Water issues	• Are there any site constraints so that on-site water management is difficult? • Are there risks of surface water pollution because of the proximity or pathways to waterbodies or wetlands? • Are there risks of groundwater problems because of shallow or rising groundwater tables, or proximity to groundwater recharge areas, or areas with high vulnerability to pollution? • Is the site susceptible to flooding?
Flora and fauna issues	• Can clearing of native vegetation be avoided • Can clearing of vegetation of high significance be avoided e.g. vegetation used for visual screening, riparian vegetation, vegetation used as corridors for the movement of fauna? • Are threatened flora and fauna species, populations and ecological communities or their habitats likely to be affected? • Can areas of native forest be avoided?
Geological or soils issues	• Are the local topographic characteristics likely to result in design and management difficulties or the inefficient use of natural resources? • Are there any geological characteristics which will cause difficulties in managing impacts (subsidence, slippage, seismic)? • Are the soils highly erodible; identify any potential management problems. • Are there any existing soils problems e.g. contaminated soils, acid sulfate or saline soils?
Transport issues	• Does the proposal in this location enhance the efficiency of the transport network including public transport? • Can the standard and capacity of the surrounding road network accommodate traffic likely to be generated directly or indirectly by the proposal • If inadequacies exist, can the road network or traffic management be changed to minimise any impacts, particularly on residential areas?
Community issues	• Is the proposal likely to be compatible with surrounding existing or proposed land uses, particularly any residential, special uses (such as schools, hospitals, community buildings), any sites of outstanding natural, environmental, agricultural or mineral value? • Does the corridor route avoid unnecessary dislocation of existing roads, and other infrastructure or utility networks? Can dislocation of residential areas be avoided, particularly severance of communities with strong community identity? Can dislocation of the operation of agriculture, forestry, commercial or industrial activities be avoided? • Is there likely to be a problem with air or water quality, or noise levels due to the proximity and nature of nearby land uses? Is the proposal likely to pose health risks? • Is the proposal likely to affect heritage values or sites of significance? • Is the site highly visible? Can significant visual impacts be avoided?
Cumulative issues	• Is the proposal at the proposed location, in concert with other recent and planned road network improvements, likely to cause cumulative problems, or contribute to existing problems (air, noise, congestion, economic hardship, social issues, inappropriate land use)?

3 NEGATIVE IMPACTS AND MITIGATION MEASURES

3.1 Land use

Adverse land use impacts may arise from the displacement of existing uses; the impairment of existing uses as a result of the road severing the area, or preventing access across it; indirect impacts on the natural resources of the area, and the induced land use change resulting from the accessibility the road provides.

In urban areas the principal land use impacts arise from acquisition of residential and business properties to allow for road construction, from the dislocation of urban activities caused by the construction of the road and its subsequent use, and the longer term impact of the new facility in improving accessibility and being a catalyst for redevelopment to capitalise on that accessibility.

In rural areas, principal impacts will also arise from acquisition and severance of rural holdings. High quality agricultural land may have its viability lessened by severance, and becomes the target for replacement land uses such as residential and industry. Prime agricultural land, relatively level and well-drained, provides an ideal alignment for roads, and many are located on it. The loss of land to the right-of-way itself may be relatively insignificant, and should routinely be taken into account in deciding whether or not to proceed with a project. The phenomenon of induced development, coupled with increasing land values along roads, can lead to conversion of large tracts of agricultural land which were not considered in planning. Such conversions may turn out to have negative impacts on national programs for sustainable agriculture and food self-sufficiency, as well as on the viability of the local agricultural economy. The land tenure of low-income landholders and indigenous people may be jeopardised by abrupt increases in land values.

Natural systems, visual amenity and historic and cultural resources may be disturbed. Natural resources, formerly protected from unplanned exploitation simply by their inaccessibility, may become accessible and therefore unprotected. Indigenous forests are particularly vulnerable to improved road access.

> In *A Souvenir of KKH–Gilgit–Hunza & Skardu* by M. Hanif Raza, an old man who lived along the newly finished Karakoram Highway is quoted as crying “Save our trees, save our valleys—save us from the timber mafia—K.K.H. has brought destruction of trees in our valleys.”

Roads on the outskirts of cities and towns are also subject to ribbon development, which causes road safety and infrastructure servicing problems, and is usually associated with visual degradation. New industry tends to locate where land is available and infrastructure exists; highway corridors are natural choices. Roadside commercial development takes place in response to speculation that improved access and greater visibility will bring more customers. Because of its unplanned nature, induced development proceeds without comprehensive consideration of impacts. Other infrastructure, especially that needed for waste management, may not exist. Social services may become overloaded. Individual induced developments also generate traffic, possibly overloading the very roads and highways which led to their existence in the first place.

The first prerequisite in mitigating adverse land use impacts is the identification of potential unplanned developments. Depending on the nature and desirability of the development, it may be prohibited, regulated or encouraged. The planning and provision of the necessary physical and social infrastructure will allow adverse impacts to be mitigated.

Restoration of access, and provision of safe road crossings should be undertaken in consultation with affected communities. Fair, timely and equitable compensation measures should be provided to any owner of acquired property.

Extract from The News, October 7, 1997

The Other View—Motorway: the new partition

The farmers living along the newly-constructed Motorway have once again become victims of the mindless 'development' drive.

Last year the farmers belonging to Central Punjab around Muridke, Narang, Gujranwala and beyond, did not pay much attention to the unusually long standing rainwater in their fields. But now when the same situation has arisen for the second year running along with the emergence of other unforeseen problems, they realise that something fundamental has changed their environs.

The crux of the problem is the six-lane Motorway running through the heart of the Punjab, which has silently disrupted the farmer's lives. It prevents water from flowing down natural slopes, the normal course it had followed for the last many centuries. The farmers, quite rightly, fear that their paddyfields are endangered because the topography of the fertile plain has been disturbed. Moreover, the Motorway's drainage system is not completely operational. Consequently, the hapless villagers anticipate waterlogging and salinity, which will prove disastrous for crops.

The Motorway was supposed to make the villagers' life easier. But it has proved otherwise. For villagers living in the Moza Dhanwal, District Sargodha, the Motorway lies between the old graveyard and their dead. They can only cross a pass—which is five miles away In fact, last Friday hundreds of farmers, carrying a loved one's body, blocked the

In fact, last Friday hundreds of farmers, carrying a loved one's body, blocked the Motorway near Bhalwal. They were demanding the construction of a bridge or an underpass to enable them to cross to the other side. As always, the police were called to thrash the poor farmers; five farmers were arrested. As if this was not enough, the police raided several houses to nab more farmers.

The Motorway has also separated hundreds of children from their schools. Their careless, early morning walks to their school located in the neighbouring village, are now a thing of the past. Just like their dead, they too have to hike for miles before starting off in the opposite direction to reach school.

Instead of providing the farmers with a link to market their produce, the Motorway has dismembered many segments of our agricultural society. It has turned into an all-encompassing disaster for the farmers. The motorway cuts through their social ties, erodes the fertility of the land, disturbs their habitat and makes cultural continuity almost impossible.

In these close-knit, inter-village communties, the Motorway will bring all micro-economic activity to a frustrating halt.

But it comes as no surprise that none of these drastic changes in the villagers' lives were thought of earlier. Our decision makers are unaware of how the villagers spend their days and nights. Nor is anyone interested in listening to their problems. All they can do is order the police to beat up the defenceless farmers. They believe this is what the farmers deserve and are used to.

3.2 Transport and traffic

The construction and subsequent use of road projects can affect the operation of the overall road network, road safety and vehicle movement patterns. During construction, care needs to be given to the routes by which construction material is brought to the site, and to the provision, identification and signing of alternative routes if existing traffic is to be disrupted. Special measures maybe needed to ensure road safety on approach routes to the site, and on alternative routes, which may need to cope with high levels of truck traffic and construction equipment.

Predictions of the likely usage of an improved or new facility, and the traffic impacts on adjacent roads, are essential if traffic impacts at the operational stage are to be managed. The predictions should include an allowance for induced land use change in the vicinity of

the road, and the contribution of additional traffic from that land use. Where major new routes are provided, the adequacy of connections to the existing road network should be investigated to avoid bottlenecks when the new route is opened to traffic.

Pedestrians, animal drawn vehicles, and pedalled vehicles are important types of traffic on roadways in many countries, especially local roads and roads leading to major market towns. Upgrading of unpaved rural roads to paved standards that does not take into account the volumes of such traffic will lead to unacceptable levels of accidents and displacement of slower modes of transport. An adequate number of safe crossings and separate or parallel restricted right-of-way for slow traffic should be incorporated into road and highway projects if there is existing or latent demand for non-motorised modes of transportation in the area

Construction procedures to avoid the disruption of local traffic should be planned and implemented. Measures to reduce road safety hazards on approach routes and alternative routes should be identified and undertaken. The adequacy of connections from new routes to the existing road network should be ensured, and special attention given to the needs of slower alternative transport modes.

3.3 Noise and vibration

Noise arising from major roads can cause significant concern amongst both urban and rural residents. In urban environments the noise can arise from both cars and trucks, and may be exacerbated by the condition of the road pavement, the traffic flow conditions (stop–start traffic causes additional noise), and the unnecessary use of horns. In rural areas the impact of new routes is particularly noticed, with a quiet rural acoustic environment being suddenly transformed by a new road.

Vibration is associated with the blasting of rock during construction and other construction activity. It can also result from the tire–road interaction of heavy vehicles. Traffic vibration is usually only an issue where routes are in very close proximity to sensitive buildings. Vibration can result in damage to buildings, and to the well being of adjacent residents.

The management of noise impacts requires a two pronged approach. Vehicle design and maintenance is essential to reduce noise at source, and this is a national responsibility. At the project level, thought needs to be given to the selection of routes which minimise noise impacts on sensitive receptors (particularly hospitals and schools). Where such receptors cannot be avoided, mitigation measures can include noise barriers and acoustic treatment of buildings. For new roads in undeveloped areas, the road reserve should be wide enough to allow for tree planting and landscaping along each side, which will also provide physical separation of the road from future development which will occur along the road.

3.4 Air quality

During construction the likely sources of emissions to air include demolition and clearing, and associated burning of waste materials, wind-borne dust arising from earthworks and quarrying, hydrocarbon emissions and odours from pavement construction.

Air emissions from operating traffic constitute a major source of air pollution for urban areas, and include nitrogen oxides, hydrocarbons, carbon monoxide, lead, sulphur dioxide and particulates. When concentrations of the above chemicals are contained by an inversion layer and subject to ultraviolet radiation from the sun, photochemical smog results.

> Exposure of “jeepney” drivers in Manila to total suspended matter, carbon monoxide, sulphur dioxide and lead was above WHO and national air quality standards. The prevalence of chronic respiratory symptoms, chronic obstructive airway disease and reduced lung function was significantly higher than in commuters. (Subsida & Torres, 1991)

The physical effects of air pollution on humans range from discomfort to death, depending on the levels and length of exposure, and the sensitivity of the individual. The emissions contribute to eye irritation, headaches, heart disease, upper respiratory illness, asthma and reduced pulmonary function. The use of lead in petrol causes atmospheric levels of lead to increase, with wide ranging health effects, particularly in infants who may suffer brain development impairment. While the effects of nitrogen oxides, lead and photochemical smog are well documented, increased attention has recently been focused on the health effects of poly-aromatic hydrocarbons and particulates.

> Atmospheric lead concentrations and blood lead levels in Jakarta and Bandung, Indonesia, were twice those of rural counterparts in 1988 (Susuki, 1990)

Mitigation measures to control dust and odour generation and minimise impacts on sensitive receptors during construction include dust suppression techniques (e.g. use of water carts to dampen the surface of haul roads), cessation of work in high winds, and air quality control systems on crushing, concrete and bitumen plants.

Potential measures to reduce operational air emissions include:

- measures to reduce emissions at source through regulation and vehicular maintenance programs, and the reduction of lead in petrol;
- measures to reduce congestion and increase public transport use;
- improvement of the efficiency of traffic through the use of transit lanes, dedicated bus lanes, truck routes, and other forms of traffic management and road pricing.

3.5 Soil stability

In siting a new facility, thorough site investigations are essential. The soils and geology of the area through which the alternative possible road alignments are proposed should be investigated and surveyed thoroughly to determine:

- if contaminants such as asbestos or arsenic pyrite occur naturally, if acid sulfate soils are to be disturbed, or if the soils are highly erodible; and a review of site history to identify likely contaminated sites;
- if contours, terrain stability, slope gradient and length pose potential problems;
- the physical and chemical properties of the soil such as soil depth, particle size distribution, permeability, dispersibility, pH and salinity;
- the suitability of soils for revegetation (the soil survey will also identify materials such as sandy clays, sands and rock, which may be a source of material for road and concrete construction);
- the susceptibility to erosion or landslip (a major problem in one section of the Lahore–Islamabad Motorway, and on the Karakoram Highway). The likelihood of seismic activity should also be ascertained from records and local knowledge, and appropriate design measures adopted.

Proposed measures to mitigate soils impacts include:

- measures to prevent wind and water erosion including programming of works to minimise the need for soil stockpiling and to minimise the area denuded of ground cover at any one time;
- stabilisation works for cuttings, embankments, river beds and banks, trenches and open channels;
- revegetation and rehabilitation measures;
- a maintenance program for all erosion control works.

3.6 Water quality

This section is particularly relevant for proposals impacting directly or indirectly on natural water bodies (rivers, lakes and wetlands). The characteristics and existing water quality of the natural water bodies which could be affected by the construction or operation of the proposal should first be determined. Then a description of the potential sources of pollution, an assessment of magnitude and probable frequency of pollution events, and the assimilation capacity of the receiving environment should be made, including:

- sedimentation and increased turbidity from run-off from stockpiles, access roads, disturbed areas, the road construction, landscaping activities, creek crossings, and bridge footings;
- contaminated discharge from workshops, vehicle washing facilities, temporary concrete, bitumen or crusher plants, equipment, fuel and chemical storage and refuelling areas;
- use of reclaimed water for dust settling and wash-down;
- run-off containing oils, greases, heavy metals, rubber and asbestos deposited on the road surface during normal vehicular operation;
- accidental spillage of chemicals, fuels and other potential pollutants, litter and dumping of rubbish.

The impacts on water quality as a result of road construction, operation and maintenance on water users (e.g. drinking water or irrigation) should also be considered.

Design and management measures to mitigate impacts include:

- measures to manage stormwater and to minimise on-flow onto the facility, and from it;
- measures to minimise sedimentation, erosion and nutrient run-off such as wet and dry basins, artificial wetlands, grass filter strips and buffer zones;
- measures to prevent contamination of water from accidental spills of chemicals or waste material;
- measures to manage water and run-off from concrete, bitumen and crushing plants.

3.7 Groundwater

If groundwater is vulnerable because of its depth, overlying geological characteristics, or the presence of recharge areas in the vicinity of the site, or if local groundwater is used as drinking water, issues which may need to be considered include:

- baseline information on groundwater aquifers (e.g. quality, movement patterns, users);
- potential sources of pollution and potential pathways (e.g. contamination from seepage from fuel storage, or contaminated surface water;

- any use of groundwater or drawing down of aquifers during construction activities or in any quarry use associated with the proposal;
- the likely impacts on the groundwater and any users from the potential pollution or change in the water table.

Measures to mitigate adverse groundwater impacts include:

- measures to prevent groundwater contamination including the bunding and sealing of fuel and chemical storages and concrete and bitumen plant areas;
- provision of alternative water supplies to any adjacent user whose groundwater sources have been affected by the construction;
- careful design so that any changes to the groundwater regime do not cause ground instability (e.g. adoption of flatter batters, and stabilisation works)

3.8 Stormwater management and flooding

If the road facility is likely to affect stormwater management in the area, or the area is flood prone, it may be desirable to undertake an integrated stormwater management strategy with the local stormwater management authority. Issues which may need to be considered include:

- the effect of any change in stormwater management as a result of the proposal on the water balance in any natural water system;
- the likely magnitude and frequency of flooding;
- the vulnerability of any facilities or construction staging areas to flooding;
- the potential impacts of inundation of the facility both on and off-site during construction and on completion;
- the security of the road, and adjacent local roads or roads under-passing the facility, during periods of high flows, and the potential impacts of floating debris;
- the potential of the proposal to alter natural flood or overland flows or change the flood liability of the surrounding area both upstream and downstream from works such as land formation, elevated sections, levees, culverts, drains or underpasses (consider flood levels , flow direction and velocities, sediment mobility and downstream scouring);
- the potential for the proposal to provide flood mitigation benefits.

Mitigation of adverse stormwater and flooding impacts can best be achieved by careful design, and the provision of adequate water-way area to take storm flows under bridges and around or under embankments.

3.9 Water supply

Consider the impact of the proposal on the water supply system including:

- the likely water usage and source of the water supply, and the effect of the proposal on the water balance in any surface or groundwater system;
- an assessment of the efficient use of water and the option to reuse recycled water.

Adverse impacts on local water supplies can be avoided or minimised by care at the design stage, when the need for water on site (for adding to the road base and sub-grade prior to compaction, and for dust suppression) should be estimated, and appropriate water supply arrangements made.

3.10 Flora and fauna

The protection of biodiversity and the maintenance of ecological processes is one of the key principles for achieving sustainable development. When terrestrial or aquatic vegetation is to be cleared, disturbed or affected by a change in water quality or quantity, or fauna habitats are likely to be disturbed, the following issues may need to be considered:

- identifying potential sources of impacts on flora or fauna such as damage to species or habitat from clearing, changes in the water regime, light, noise or dust;
- identifying terrestrial and aquatic plant, animal or fish habitats and, where appropriate, ecological communities, populations and species in areas that may be directly or indirectly affected by the proposal (e.g. local and regional significance, threatened species);
- the potential impacts of the proposal on the number, size, distribution, inter-relationships or health of species, and in particular the sensitivity of species and the timing of the disturbance relative to their breeding and migration cycle;
- the impacts on remnant vegetation, for example, wildlife corridors;
- the impacts on existing weed, vermin or pest problems, including on their numbers and distribution, and the possibility of introducing new pest plants;
- if relevant, the impact on species or habitat protected under international agreements, treaties or conventions.

A management strategy (together with landscaping and rehabilitation plans) should be adopted to minimise impacts on flora and fauna, including measures such as:

- provision of new habitats, or compensatory rehabilitation or restocking of indigenous species;
- details of any proposed methods to protect species or their habitats from accidental damage during construction or operation of the proposal;
- timing of major disturbances to minimise impacts on breeding and migration cycles.

3.11 Social

For proposals with potentially significant community impacts, the following issues may need to be considered:

- an overview of the community likely to be affected, in particular identifying any sectors which are likely to be disadvantaged;
- a review of the community consultation process identifying any issues raised by the community;
- properties to be acquired (in whole or part) and any residents or businesses requiring relocation; any resulting potential social impacts from relocation of residents, businesses or employment;
- the impacts from construction and operation of the proposal as a result of changes in air quality or from noise, vibration, or lighting, overshadowing or visual impacts, safety hazards, or from severance or disruption to the community, and in particular:

    impacts on community identity and cohesion or the cultural or physical character of the location;

    disruption of the community including loss of access to community facilities, links to other communities or recreation or leisure opportunities;

    loss of amenity including public safety, security, privacy or a sense of well-being;

impacts on health, and road safety implications for pedestrians, cyclists, vehicular traffic as well as residents living adjacent to the faciity;

social implications of impacts on local businesses, industries, agricultural activities, tourism and employment.

- the affect of the proposal on future development in the area; impacts on demographic make-up due to redevelopment, changes in land use and changes in land values; and potential flow-on effects in terms of demand on community services.

Measures to mitigate potential social impacts will usually involve design changes to avoid community severance and the loss of valued amenity, and where that is not possible, the provision or replacement of facilities and community services which have been impacted. Adverse social impacts cannot be mitigated without understanding the values and needs of the local community through public consultation, and responding to all reasonable and viable suggestions for improvements to the project design.

3.12 Landscape and visual amenity

For proposals which are located in areas where visual impacts are likely to be a concern or if there is major land clearing or tree cutting, issues which may need to be considered include:

- the visual significance of the landscape to be affected from the fore, middle and background; the visual quality of the area including unique visual aspects, land use and the extent of visual degradation; the consideration of the proposal in relation to any landscapes or feature of local or regional significance or sensitivity;
- potential sources of visual impacts from the proposal, such as significant built forms like bridges, embankments, cuttings, overpasses, road signs, clearing and temporary construction facilities and stockpiles;
- assessment of the visibility from surrounding areas, and the potential visual impact, taking into account the visual absorption capacity of the area (including the scale and compatibility of the proposal with the existing visual environment and land uses) and the visibility of the road from adjoining properties and surrounding areas.

Detailed plans should be prepared and implemented for the landscaping and rehabilitation of construction areas and road verges and corridors. The composition of intended screening species should be chosen, to the greatest degree possible, from species indigenous to the area. Adequate funding for maintenance of the landscape plant material should be budgeted. The design and detailing of bridges, overpasses and other structures should be undertaken with the goal of achieving visual harmony.

3.13 Heritage values

Where the proposal is likely to disturb or affect any heritage values, the following issues may need consideration;

- identification of any items of heritage significance on the site, the collation of information from existing sources such as a relevant heritage study or conservation plan, and a survey of the area to be affected to identify any items of potential heritage significance;
- for cultural heritage, assessment of the cultural, archeological and anthropological significance of any item or place identified;
- for natural heritage, assessment of the heritage significance of any natural areas including geological or palaeontological features or ecological communities.

Every effort should be made to avoid significant heritage values. In the event that some disturbance is unavoidable, expert advice on measures to mitigate the impact should be obtained. This will often take the form of a conservation management plan, which will detail measures for the scientific recording and relocation of any artifacts which will be disturbed.

3.14 Hazards

All potential hazards and associated scenarios should be identified, and the significance of their consequences assessed. If risks are likely to be significant, they should be quantified where possible. Hazard mitigation measures should be described.

- for road facilities with a risk of accidental chemical releases or explosions during construction (e.g. storage of explosives for blasting), or if hazardous materials are likely to be transported on the facility, the following issues may need to be included:

  where hazardous materials are to be used on site, a list of hazardous materials and anticipated rates of usage, storage and transport arrangements. The identification of possible causes of potentially hazardous incidents, the likelihood of occurrence and their consequences to public safety and the environment should be examined, and operational and organisational safety controls to reduce hazard risk and environmental impacts should be specified.

  Where hazardous materials are likely to be transported on the facility, road related hazards which may lead to incidents (e.g. road standard, design, ice, fog, sunlight glare) should be identified, and the likelihood of occurrence of an incident and the consequences for public safety and the environment should be examined.

- Where road proposals are likely to experience natural hazards, the likely performance of the facility during exposure to such hazards (e.g. earthquakes, land slips, subsidence, flooding and severe storms) should be documented, together with the likely consequences.

Measures to minimise and manage hazards which have been identified should be implemented. These can include the safe storage of chemicals and explosives on site, the regulation of the transport of dangerous goods, the stabilisation of slopes prone to slippage and design factors for structures subject to seismic activity. The road authority, in cooperation with regional authorities, should prepare a Disaster Emergency Plan which will specify actions to be taken if an emergency event occurs. Matters that should be covered in the plan include a management structure for assuming responsibility for the emergency response, the roles and coordination of the various authorities (police, health workers, local authorities etc.), measures to re-route traffic until the emergency situation is rectified, and measures to clean up any environmental damage which may have resulted from the incident.

3.15 Economic issues

Issues which may need to be considered include:

- the costs and benefits of providing, operating and maintaining the road facility relative to alternatives (including the do nothing option). Significant non-monetary costs and benefits should be described and quantitatively assessed. The analysis should consider:

  construction and maintenance costs, and flow on effects from the need to augment or increase the maintenance budget for local or regional roads;

  operational costs and benefits such as travel time savings, accident savings, savings in vehicle operating costs (i.e. fuel and maintenance);

- environmental and social costs and benefits such as the effects on human health, habitat value, and amenity;

- where the road proposal is likely to have an impact on a particular region, community or local economy, economic studies which consider impacts on existing and future development and settlement patterns, such as:

    the potential impacts on property values;

    the stimulation of residential and tourist developments;

    impacts on, and arising from, agriculture and forestry;

    impacts on commercial and industrial activity resulting from changes in freight transport options, changes in haulage costs, and accessibility;

    any additional employment as a result of the proposal;

    town bypasses resulting in the loss of passing trade for retail businesses;

- the proposed funding arrangements for the scheme, and the financial implications of any user tolls or charges which are levied.

Significant adverse economic impacts will usually result in a proposal being abandoned. If a proposal is to be implemented, but has some significant adverse impacts, assistance packages to assist the sector adversely affected should be prepared and implemented. In the interests of equity, no sector of the community should be left worse off for the public good.

3.16 Health

Road projects built in flat terrain and valley bottoms, especially in areas of heavy seasonal rainfall and clay soils, are often elevated on earthen embankments above ground level. Such routes built along hillsides, though not elevated above grade, may block rainfall runoff patterns. Without proper placement of culverts and other drainage measures, pooling of water is inevitable. Large volumes of soil extracted during construction can result in flooded borrow pits. Malaria mosquitoes may proliferate in the surface waters and the transmission of malaria may be intensified.

> Increased malaria has been documented for road construction in the Amazon Basin, Liberia and Kenya. In 1974 some 50% of the malaria in Amazonia was linked to the narrow area of influence of the Transamazon Highway (Ault,1989; Coimbra, 1988)

Road-side storm water drains in coastal tropical towns and cities are often the sole disposal point for waste. The drains become blocked by solid waste, providing breeding sites for mosquitoes that transmit filariasis and other diseases. Spread of parasitic diseases whose ova are passed in excreta is strongly associated with the use of roadside ditches as latrines. The excreta may be washed downstream to nearby moist places where transmission occurs.

> Filariasis is endemic in coastal Indian towns. As part of a road upgrading program, kerb-side L-shaped drains were replaced by deep U-shaped open drains. The new drains were soon filled with rubbish. Because they were much more difficult to clean out than the old drains, mosquito breeding increased.

Unplanned settlements, rest houses, food stalls and garages proliferate along the course of new roads. Often they are situated near ponds where vector mosquitoes and snails breed. The residents of such settlements may have no access to health care facilities. Such informal settlements may serve as a focus for STD transmission by long distance truck and taxi drivers. Workers engaged in the construction of roads through undisturbed countryside may contact natural disease foci (e.g. scrub typhus in Southeast Asia).

By contrast, road improvements can greatly improve access to health facilities for poor rural communities. Roads simplify the circulation of health workers, improving the identification, treatment and control of communicable diseases such as tuberculosis. They also may improve the provision of assistance in emergencies such as famine.

Awareness of potential health impacts, and good design practice to avoid ponded water, to prevent the accumulation of rubbish and wastes, and the careful planning and control of service areas and ribbon development will minimise the likelihood of adverse health impacts.

3.17 Cumulative impacts

The principal cumulative impacts of road proposals result from increased traffic, causing increased fuel usage and air emissions. Particularly in urban areas, the air emissions can lead to the production of photo-chemical smog. Overall increases in fuel use and air emissions contribute to the Greenhouse effect, a world wide phenomena. Where the anticipated levels of vehicle usage are expected to significantly contribute to fuel use and the overall emissions already being experienced, these issues should be considered.

Other aspects that may relate to the cumulative impacts of particular road proposals include:

- the potential for cumulative impacts from other existing or planned transport facilities in the region;
- any advantages or disadvantages from clustering development and road facilities in this location;
- whether the road would prevent, inhibit or improve the development of (or affect the viability of) other forms of transport, now or in the future;
- whether the proposal would attract development, and the likely impacts of that development;
- any long term cumulative impacts on the issues listed from 3.1 to 3.16 above.

Cumulative impacts are often the most difficult to mitigate, and can best be addressed through early identification and design changes. In many cases (e.g. urban sprawl, regional air quality, drinking water quality) they require a regional approach by government. The key to the successful management of cumulative impacts is a knowledge of the limits to the assimilative capacity of the receiving environmen

4 MANAGEMENT AND MONITORING

4.1 The environmental management plan

As detailed in Section 4.3 of the *"Guidelines for the Preparation and Review of Environmental Reports",* an environmental management plan (**EMP**) should provide a framework for managing or mitigating environmental impacts for the life of the project. For road projects, the outline of the EMP should demonstrate sound environmental practices during the construction and operation of the proposal, including:

- the management of construction impacts (e.g. erosion, sedimentation, noise, rehabilitation and revegetation of disturbed land);
- the management of operational impacts (e.g. traffic management, maintenance, landscape management, contingencies for emergencies and operational incident management);
- strategies to feed information from the monitoring program back into the management practices and actions to improve environmental performance;
- training programs for staff and incentives for environmentally sound performance.

4.2 Monitoring

Monitoring should begin before design and construction to determine baseline conditions. Baseline conditions are described by conducting a detailed analysis of the existing condition in each significant likely impact area (e.g. ambient air quality, river and stream water quality, social and health conditions of adjoining communities). Baseline data collection methodology is covered in Section 3.4 of *the "Guidelines for the preparation and review of Environmental Reports"*.

Monitoring should be restricted to that which is essential to protect the environment. The list of environmental parameters to be monitored should be accompanied by an explanation of why each of the parameters needed. The design and management of a monitoring plan for a major project is discussed in Section 5.2 of the *"Guidelines for the preparation and review of Environmental Reports"*.

Key aspects of monitoring for road projects include surface water management and quality, land surface erosion, and hazards (deterioration of cuttings and structures, pavement quality and traffic conditions).

5 References

The development of these guidelines rely heavily on the following sources:

- Government of Pakistan EIA Guidelines 1986
- ADB *Environmental Guidelines for selected Infrastructure Projects Guidelines* 1993
- ADB *Environment Paper No 11, Guidelines for the Health Impact Assessment of Development Projects* 1992
- The World Bank *Environmental Assessment Sourcebook* 1994, Volume II, Sectoral Guidelines (Rural Roads)
- The NSW *EIS Guidelines (Roads and Related Facilities)* 1996

Actions affecting environmental resources and values	Potential damage to the environment	Recommended protection and mitigation measures
1. Site selection	See Table 1 on page 4	Depends on nature of problem —reject site if inappropriate
2. Land use		
(a) displacement of existing uses	loss of livelihood and cultural amenity for those persons displaced	adequate resettlement and compensation to allow viable lifestyle to continue
(b) severance	reduces access to, and viability of, land uses	reinstatement of access, and amalgamation of severed properties
(c) indirect impacts on natural resources	loss of natural resources and ecosystems	management planning and controls to protect sensitive resources and ecosystems
(d) induced land use change	loss of traditional uses, and deterioration of environment from unplanned change	implement strong planning controls where essential, and plan to provide infrastructure for inevitable land use change
3. Transport and traffic		
(a) dislocation of traffic during construction	safety and convenience for existing road users can be jeopardised	adequate planning of the delivery of construction materials, and the provision and signing of alternative routes for local traffic
(b) adequate planning for safe operating conditions	bottlenecks and congestion can led to accidents and pollution	adequate planning of future traffic volumes (including traffic from induced development) and provision of suitable connections to the existing road network
(c) lack of provision for a variety of road users	safety and convenience for existing road users can be jeopardised	provide adequate road space for public transport and slower non-motorised transport modes including cyclists & pedestrians
4. Noise and vibration		
(a) vehicle noise at source	stress and hearing loss	introduce and enforce national standards
(b) noise from traffic stream	sleep interference and reduced speech intelligibility	ensure major new roads have wide road reservations to allow treed buffer; provide noise barriers and acoustic treatment to protect sensitive receptors
5. Air quality		
(a) construction	damage to human health	control dust and odour generation by watering haul roads, ceasing work in high winds, and adopting air quality control systems on crushing, concrete and bitumen plants
(b) operations	damage to human health	regulate to reduce emissions at source & remove lead from petrol; increase public transport use and reduce congestion through traffic management
6. Soil stability and erosion	environmental degradation	minimise area denuded of ground cover at any one time; stabilise cuttings, embankments, river banks, trenches and open channels; revegetate cleared surfaces

7. Water quality		
(a) erosion and sedimentation	degradation of natural water bodies and wildlife habitats	minimise stormwater flow onto the project site, and from it: minimise erosion, sedimentation and nutrient run-off (e.g. artificial basins and wetlands, grass filter strips and buffers
(b) contamination from accidental spills	degradation of natural water bodies and wildlife habitats	bund storages of chemicals, and collect wash down water and run-off from concrete, bitumen and crushing plants for clean-up and re-use
8. Ground water	impairment of beneficial uses; changes to groundwater levels	prevent groundwater contamination by bunding and sealing fuel and chemical storages; compensate landowners affected by lowered water tables and provide alternative water sources; allow for stability effects in design process.
9. Stormwater management and flooding	threat to human health and amenity, and to natural systems	allow for flood impacts of the in design process; provide adequate water-way area under bridges and around embankments
10. Water supply	deprivation of other users	make arrangements for water supply that do not impact on existing users; re-use and recycle water on site
11. Flora and fauna	destruction of habitats and species	provide compensatory habitat; protect habitat from accidental damage; time disturbances to minimise impacts on breeding cycle
12. Social	breakdown of community well-being and cohesion	if community severance and loss of valued community facilities and amenity are unavoidable, provide replacement facilities;
13. Landscape and visual amenity	loss of aesthetic values and human amenity	design, implement and maintain detailed rehabilitation and landscaping works for cleared construction areas; aim for visual harmony in bridges and other structures
14. Heritage values	loss of cultural heritage	record and relocate artifacts in accordance with a conservation plan
15. Hazards		
(a) during construction	threat to human life and the environment	carefully store chemicals and explosives and implement safety procedures for their use
(b) during operations	threat to human life and environmental degradation	road related hazards (sight distance, fog, ice) should be minimised through good design and maintenance practices, and operational emergency procedures to respond to accidents involving hazardous chemicals should be prepared and practiced
(c) natural hazards	threat to human well being	road design parameters should allow for natural hazards (e.g. seismic activity and land slips). A Disaster Plan should be prepared in cooperation with regional authorities.
16. Economic issues	impacts on the local and regional economy (e.g. displaced activity, induced development, tourism, and town bypasses)	assistance programs may be necessary, to ensure that communities are able to cope with the predicted changes. In cases of rapid induced development, infrastructure (power and water supply, and waste management facilities) will need to be provided.
17. Health	spread of mosquito borne and communicable	good planning and design will minimise the likelihood of ponded water, the accumulation of

diseases	wastes, and service areas problems.