Mitigation for large scale housing projects

	Potential negative impacts	Mitigating measure
DIRECT IMPACTS		
1.	Displacement of existing land uses	Ensure that due consideration is given to the proper trade-offs between land values for housing and those of other uses, such as prime farmland, forests or other land uses or natural habitats of value to society as a whole. Investigate existing planning and design standards to ensure that they are suited to local conditions and not unnecessarily wasteful of land. Assist in drafting new regulations that are more appropriate.
2.	Destruction of environmentally critical areas	Ensure that regionally critical environmental sites, such as major forested areas, major water bodies and wetlands, habitats containing rare and endangered species, etc., are identified and not threatened by project location.
3.	Danger to residents from hazardous natural conditions	Ensure that project site is not located in the following areas: • major floodplain • coastal zone inundation areas • areas of unstable soil or subsurface conditions • areas of highly saline soils • areas subject to landslides • seismically or volcanically active areas • excessively steep or wet areas • areas where significant risk from disease vectors exist or any other areas of significant natural hazard. Design accordingly if site cannot be moved.
4.	Danger to residents from hazardous man-made conditions	Identify areas that have significant man-made hazards such as filled land, areas subject to subsidence from mining activity, groundwater, oil or other extractive process. Identify areas where solid or liquid or toxic wastes may be, or have been, dumped. Investigate site conditions with proper geo-technical or chemical testing procedures. Ensure that adequate funding and technical expertise are available to deal with the special conditions. Investigate alternate sites.
5.	Hazard to residents from air, water or noise pollution from other adjacent or nearby land uses	Ensure that the site is located away from such pollution sources. Do not locate down-wind of significant point sources of air pollution such as smoke stacks. Identify noise sheds around airports, major roads, etc. Provide buffers of other compatible uses of adequate width between residential areas and sources of pollution. Take measures to abate pollution at source, if feasible; such as noise barriers along expressways are an example. Investigate alternate sites.
6.	Hazard to residents from air pollution due to site location being in an area subject to frequent temperature inversions	Seek alternate site locations if pollution is from existing sources that are difficult to abate. Otherwise design project with low densities and non-polluting technologies for heating, cooking, etc.
7.	Dislocation of existing resident populations	Ensure that any involuntary resettlement is done in accordance with proper standards or consider alternate sites.
8.	Destruction of historic or cultural resources	Consider alternate sites or make provisionto set aside and zone historic and culturally significant areas.

Mitigation for large scale housing projects (continued)

9.	Overloading of existing infrastructure and services	Coordinate with other planning goals and objectives for region. Upgrade existing infrastructure and services, if feasible. Consider alternate sites.
10.	Excessive depletion of resources such as lumber or fuel or overtaxing of traditional industries, such as brickmaking	Review capacity of local resources and industries to provide for large-scale construction and upgrade if feasible. Select materials and design criteria according to local conditions and availability of resources. Design for maximum efficiency in material and energy use. Encourage the study of indigenous customs and techniques for building and incorporate in project design.
LOCAL AND SITE SCALE IMPACTS		
11.	Damage to sites and their immediate surroundings resulting from the disruption of the natural environment, in particular the soil, vegetation and drainage network (see below for more detailed comments).	Identify the basic natural systems of a site and its immediate surroundings and protect with set-asides for open space, easements and buffer areas etc. Adapt layouts to fit natural patterns rather than imposing rigid geometries.
12.	Degradation of habitats caused by fragmentation	Maintain and/or design open space networks to follow natural site features, such as stream corridors, and connect the site and local and regional open space systems.
13.	More extreme flood/drought cycles, increased erosion and siltation and degradation of stream biota and riparian vegetation etc caused by increased runoff from developed sites	Preserve existing vegetation, particularly intact natural habitats. Institute a stormwater management plan including strategies such as: • minimising impervious area • increasing infiltration to soil by use of recharge areas • use of natural vegetated swales instead of pipes or • installing detention or retention facilities with graduated outlet control structures. Use 'soft engineering' techniques for soil and bank stabilization such as vegetative stabilization (soil bio-engineering), in preference to built structures.
14.	Depletion and/or pollution of local groundwater resources	Ensure that projected use of groundwater is within the capacity of natural system to replenish itself. Avoid 'mining' groundwater particularly in drier climates. Use indigenous vegetation that requires less water, drip irrigation or shaded plantings. Ensure that soils are suitable for septic tank or other on-site treatment. Design stormwater management systems as suggested above, in particular use vegetation to retain recharge and purify stormwater.
15.	Degradation of soil cover from erosion, removal, or loss of soil structure due to compaction	Have both temporary (during construction) and permanent erosion control plans. Temporary control plans should include: • silt fencing • temporary silt trap basins • short term seeding or mulching of exposed soil areas (particularly on slopes) • limitations on access for heavy machinery and the storage of materials to avoid soil compaction. Permanent erosion control plans should focus on the establishment of stable native vegetation communities. Ensure that topsoil in construction areas is stripped and stored for future use and not illegally removed from site.

Mitigation for large scale housing projects

Potential Negative Impacts	Mitigating Measure
16. Loss or degradation of vegetation from unnecessary removal or mechanical damage	Identify important stands of vegetation, large contiguous stands of forest or other habitat, vegetation on steep slopes, and stream corridors or swales. Incorporate these areas into design layout or open space system. Protect such areas during construction by temporary fencing and limitations on access for heavy machinery and materials storage.
17. Degradation of habitat from inappropriate management or introduction of invasive exotic species	Protect natural habitat from destructive management or maintenance practices, such as the removal of understorey vegetation from woodlands, or excessive clearance of vegetation from stream banks. Do not use invasive exotic species for landscaping or reforestation.

From: Environmental Assessment Sourcebook (World Bank, 1991)

Mitigation for roads and highways

Potential negative impacts		Mitigating measure
DIRECT IMPACTS		
1.	Increased sediment in streams affected by erosion at construction sites and fresh road cuts, fills and waste dumps.	Protect susceptible surfaces with mulch or fabric, and plant non-erodible surfaces as soon as possible.
2.	Soil and water contamination by oil, grease, fuel and paint in equipment yards and asphalt plants.	Collect and recycle lubricants. Avoid accidental spills through good practice.
3.	Air pollution from asphalt plants.	Install and operate air pollution control equipment.
4.	Local dust and noise.	Periodically water down or lightly oil temporary roads. Install and maintain mufflers on equipment.
5.	Air and noise pollution from vehicle operation, in populated areas traversed by the highway, notably metropolitan areas or densely settled rural areas.	Include physical barriers to noise in plans. Require adherence to engine maintenance schedules and standards (or use alternative fuels) to reduce air pollution. Enhance public transportation and traffic management capability.
6.	Landscape disfiguration by embankments and deep cuts, fills and quarries.	Use an architectural design to 'blend' with the landscape. Replant disfigured surfaces.
7.	Landslides, slumps, slips and other mass movements in road cuts.	Provide drainage works as needed to reduce risk, according to prior surveys. Align route to avoid inherently unstable areas. Stabilize road cuts with structures (concrete walls, dry wall masonry, gabions, etc).
8.	Erosion of lands below the road bed receiving concentrated outflow from covered or open drains.	Increase number of drain outlets. Place drain outlets so as to avoid cascade effect, Line receiving surface with stones, concrete.
9.	Roadside litter.	Provide for disposal facilities. Encourage anti-littering laws and regulations.
10.	Hazardous driving conditions where construction interferes with pre-existing roads.	Provide in design for proper markers on roads, including lights.
11.	Alteration of overland drainage and subsoil drainage (where road cuts intercept perched water tables, springs etc).	Installation of adequate drainage works.
12.	Destruction of vegetation and wildlife in the right-of-way occupied by the highway.	Realignment where possible to detour exceptional areas, identified by prior surveys.
13.	Destruction or damage of terrestrial wildlife habitats, biological resources or ecosystems that should be preserved.	Plan national transportation route alignment to avoid location of fragile, unique, etc areas.
14.	Alteration of hydrological regimes of wetlands by causeways, with harmful effects on these ecosystems.	Realignment to avoid wetlands. Installation of culverts, bridges, etc as needed and according to criteria from prior hydrological surveys.
15.	Interruption of migratory routes for wildlife and livestock. Increased collisions with animals.	Realign to avoid important migratory routes. Provide undergrade crossings.
16.	Poor sanitation and solid waste disposal in construction camps and work sites.	Provide adequately located and maintained latrines.
17.	Possible transmission of communicable diseases from workers to local populations and vice-versa.	Periodic health examinations of workers with treatment when needed.

Mitigation for roads and highways

Potential Negative Impacts	Mitigating Measure
18. Creation of temporary breeding habitats for mosquito vectors of disease, e.g. sunny, stagnant pools of water.	Assess vector ecology in work areas and take steps where possible to avoid creating habitats.
19. Creation of transmission corridor for diseases, pests, weeds and other undesirable organisms.	Set up plant and animal sanitation service and related checkpoints.
20. Poaching by construction workers.	Prohibit poaching under terms of employment.
21. Dislocation and compulsory resettlement of people living on the right-of-way. (Near cities and in rich farming regions, many people can be affected.)	Locally unprecedented mechanisms and procedures may be required to arrive at equitable and adequate compensation, and a companion effort to develop the capacity may be required.
22. Obstruction of routes from homes to farms, etc., increasing travel time.	Provide appropriately designed and located crossings.
23. Impairment of non-motored transportation in the highway corridor due to reduced or impeded rights-of-way.	Design and implement safety measures and an emergency plan to contain damages from accidental spills. Designate special routes for hazardous materials transport.
INDIRECT	
25. Induced development: roadside commercial, industrial, residential and 'urban sprawl'.	Involve land-use planning agencies at all levels in project design and EA and plan for controlled development.
26. Increased motorized transportation (with possible increased dependency on imported fuels).	Include project components to encourage use of no-motorized transportation.
27. Impairment of non-motorized transportation economy due to changes in land use and/or increased availability of motorized alternatives.	Include project components to stimulate local production and use of non-motorized modes of transportation.

From: Environmental Assessment Sourcebook (World Bank, 1991)

Note: Further information and examples of mitigating measures for other types of projects can be located in the Sourcebook.

Preparing an impact management plan

1. Note or establish an environmental policy for the proposal

- An environmental policy for a proposal should contain a concise statement of the commitment to certain standards of environmental performance and behaviour. It could for instance state that 'maximum use will be made of locally grown plantation timbers' or that 'all contractors will be required to produce their own environmental management plans and quality reports as the initial part of their contracts.'
- Think of ways to raise stakeholder awareness and commitment to the policy (employees, contractors, suppliers, client, community) and to ensure that they understand what is trying to be achieved and why

2. Designate a person to take overall responsibility for the impact management plan

A person or a group should be specifically allocated responsibility for the development, implementation and performance review of the impact management plan.

3. Identify tasks

- Examine the EIA and the conditions for approval to identify all commitments and obligations made regarding the environment.
- Identify any other environmental /impact management requirements arising from regulations, policies, guidelines, etc.
- Identify requirements for staff training.
- Identify a range of implementation tools that can be used to ensure that impact management is undertaken e.g. setting objective conditions for contracts, tenders, permits and licenses, establishing performance bonds to ensure environmental outcomes are achieved, etc.

4. Establish a plan and allocate responsibility

- Draw up a time based schedule of the identified tasks and allocate responsibility for each of them (see sample outline).
- Develop contingency plans that highlights actions to be taken and assigns obligations in the event of the detection of unacceptable adverse impacts.
- Check that those undertaking the detailed design of the project incorporate all commitments and obligations.
- Budget for the plan.

Impact Management Plan-sample task schedule

No.	Task Description	Responsible person/unit	Start Date	Finish Date	2002				2003				2004			

5. Develop a management system for monitoring, reporting and response

- Identify monitoring requirements and responsibilities.
- Establish a system of reporting at intervals that are appropriate to the various tasks (daily, weekly, monthly).
- Establish a system for data storage, retrieval and access.
- Establish a system for investigating and responding to complaints and enquires from outside parties.

6. Implement management system

7. Review performance

- Establish a system of meetings to review issues arising out of the reporting and to focus on preventative and remedial measures.
- Conduct independent audits (compliance and surveillance) regularly.
- Update/review the impact management plan regularly.