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CONTROLLING DEFORESTATION IN LATIN AMERICA: A CHECKLIST OF
POLICY REFORMS FOR GOVERNMENTS TO FOLLOW.

This list outlines reforms in development policies and practices which, if implemented, would help to prevent further deforestation in Latin America. International development agencies should encourage and assist Latin American governments to implement these reforms through appropriate projects, loan conditionality, and policy dialogue.

1. Highways and Rural Roads:

- a. Avoid any new roads intended primarily to promote forest colonization.
- b. Where roads are needed to connect population centers, site them to avoid crossing major wildland areas. If this is not feasible, establish a protected area with adequate control (as with Braulio Carrillo National Park along the new Guapiles-San Jose highway in Costa Rica).
- c. In Amazonia, promote improved river transportation as an alternative to more highways.

2. Protected Wildland Areas:

- a. Establish new protected areas, especially in ecosystem types not well (or at all) represented in the existing protected area network. These should include both "strictly protected areas" (such as national parks) and extensive "multiple use areas" (such as extractive reserves).
- b. Strengthen the on-the-ground protection of existing "paper parks", through adequate (well-paid and trained) staff, budgets, management plans, park infrastructure, equipment, spare parts, fuel, etc.
- c. Ensure that each major development project which affects wildlands, or depends upon wildlands for its proper functioning, contains a wildland protection component.
- d. Ensure that each relevant government agency is provided with accurate, up-to-date maps of legally protected wildland areas (so that inappropriate development projects are not planned in them).
- e. Develop appropriate mechanisms, such as "user fees" and "proprietary funds", to channel money from the beneficiaries of wildland management (such as electricity and water users, fishermen, and tourists) towards meeting the recurrent costs of proper wildland management.

f. Collaborate closely with national and international conservation NGOs in the establishment or on-the-ground management of protected areas.

3. Environmental Institutional Strengthening:

a. Strengthen existing environmental ministries; forestry, wildlife, and parks departments; and similar agencies through increased budgets, staffing, training, and (where needed) reorganization. Require environmental agency approval before construction can begin on any development project with biodiversity implications.

b. Establish strong and well-staffed environmental assessment and control units within implementive ministries and agencies, particularly road-building and public works, agriculture and livestock, agrarian reform, hydroelectric power, and mining, as well as planning ministries and governmental development banks.

c. Review for consistency and adequacy existing laws on endangered species, protected areas, wildlife, forestry, fisheries, water development, mining, environmental protection, and land tenure; pass new legislation, or repeal (or simplify) existing laws as needed. Enforce realistic penalties for violators, with a fraction of penalty revenues going to forest or park guards as a reward (and the rest to the forestry or park agency, rather than to general government revenues).

d. Support establishment of conservation data centers (CDCs) (which gather and provide information on the status and location of threatened species and ecosystems), either within appropriate government agencies or qualified NGOs. Ensure that the CDCs are consulted when new development projects are planned.

e. Develop IUCN-style National Conservation Strategies or similar national (or sub-national) environmental planning mechanisms.

f. Join, ratify, and participate actively in all relevant international environmental agreements, including (Ramsar) Wetlands Convention, World Heritage Convention, CITES, Migratory Species Convention, Caribbean Environmental Action Plan, Treaty of Amazonian Cooperation, Law of the Sea, Western Hemisphere Convention, and Vicuna Convention.

4. Land Tenure and Titling:

a. Use agro-ecological zoning to determine land titling. Within agriculturally unsuitable zones, prohibit all granting of land titles (or other legal land use rights, such as "derechos posesorios").

b. Within agriculturally suitable zones, rationalize and speed up land titling procedures, to increase land tenure

security and thereby encourage long-term land investments (including sustainable forestry, tree and perennial crops, and other alternatives to pasture). Newly-issued private land titles should be no larger than required to support a family sustainably at an adequate standard of living.

c. Repeal forest clearing as a prerequisite for obtaining land title or demonstrating "effective use". Do not treat forest clearing per se as a land "improvement", or as proof of land occupation. Require maintenance of forest cover as legal evidence of effective use in "forest only" zones (as determined by agro-ecological zoning). Direct land reform programs at underutilized non-forest lands (especially pastures), not at forested areas.

d. Require that a specified proportion of larger "forest frontier" landholdings be maintained in forest as a condition for obtaining (or maintaining) legal title.

e. For forest-based extractive activities, grant revokable forest use concessions, rather than land titles. Timber concessions should be for longer than the estimated logging rotation time.

5. Agricultural Credit and Other Rural Services:

a. Use agro-ecological zoning to determine where to provide rural services such as credit, agricultural support services (including veterinary care), road improvements, electrification, and schools. Provide these services only in zones ecologically suitable for agriculture (or other intended land uses).

b. Restrict credit and most other services to already deforested (non-frontier) areas, except where credit or other services in frontier zones will enable existing colonists to switch to more land-conserving production systems (e.g. from cattle to perennial crops).

c. Ideally, prohibit agricultural loans to all cattle ranchers, except for very intensive systems (such as cultivated, hand-cut pasture for dairying), or in areas of natural grazing lands (which can support grazing without the removal of trees or other woody vegetation). (These include the llanos of parts of Venezuela and Colombia, the cerrado of central Brazil, the puna of Peru and Bolivia, and the temperate grasslands of Argentina and Uruguay, as well as north-central Mexico).

d. Alternatively, limit cattle credit to non-frontier areas where grazing is sustainable, raise interest rates (preferably to commercial levels), and/or make cattle credit conditional upon no further forest clearing on applicants' landholdings.

6. Directed Colonization:

a. Restrict government-supported small farmer colonization

programs to agriculturally suitable non-forest lands.

b. Get agrarian reform agencies to acquire pasture lands on suitable soils for redistribution to small farmers, rather than promoting colonization of forested areas.

7. Tax Policies:

a. Increase taxes on pasture lands, to encourage more intensive agricultural production (or reversion to forest), and to discourage land speculation.

b. Provide tax breaks for private lands that are maintained in forest.

c. Improve collection of rural land taxes (especially in frontier areas); index tax rates to inflation rates.

d. Use agricultural income taxes (such as a capital gains tax for land value appreciation) to discourage land clearing and speculation.

e. Avoid providing any fiscal incentives for frontier investments (such as cattle ranches) that cause deforestation.

8. Alternative Employment Opportunities: Encourage all forms of employment (rural and urban) that provide an attractive alternative to colonizing and clearing the forest.

a. In rural areas, promote economic diversification, agricultural processing and other value-added activities, more labor-intensive crops and agricultural technologies, cottage industries, etc. Discourage agricultural practices which reduce employment; avoid tax, credit, or other subsidies for labor-displacing mechanization.

b. In urban areas, encourage "microentrepreneurship" and other labor-intensive economic activities; support cheap housing, safe water supplies, education and health services, and other programs to make these areas more attractive to would-be forest colonists.

9. Power Sector Reforms:

a. Encourage hydroelectric projects which flood relatively little land for the amount of power they generate; avoid very large reservoirs in wildland areas. (The relatively small Pehuenche reservoir in Chile generates 1,250 kilowatts per hectare flooded, while the huge Brokopondo reservoir in Suriname produces only 0.2 KW/ha.)

b. Choose hydroelectric dam sites where additional tributaries (the more, the better) exist downriver. This will minimize the dam's effects in blocking fish migrations or in reducing the water, nutrient, or sediment supply to downriver wetlands and

estuaries.

- c. Choose hydroproject sites on rivers that already have one or more dams on them, since the marginal ecological impact of a new dam will be smaller.
- d. For every hydroelectric project, ensure proper watershed management, especially natural forest conservation and control of road construction.

10. Forestry Policy Reforms:

- a. Minimize logging road construction, using alternative extraction techniques (such as river floating or aerial cables) whenever feasible.
- b. Raise stumpage fees or taxes, to increase revenues to the government forestry agency and to discourage wasteful logging practices.
- c. To discourage "high-grading", charge stumpage fees or taxes according to the volume of timber available (rather than volume extracted), and adjusted to different tree species.
- d. Award timber concessions on public forest lands according to competitive bidding, rather than individually-negotiated agreements.
- e. Encourage vertical integration in the forest industry.
- f. Provide forestry technical assistance to landholders.
- g. Encourage the development of an integrated mix of forest products from each site, to maximize the commercial value of wood harvested.
- h. Promote or require more efficient sawmills or other wood processing technologies.
- i. Help inform and organize forest landholders, so that they receive higher prices from loggers, truckers, or sawmillers.

11. Monitoring of Deforestation and Other Land Use Changes:

- a. Use LANDSAT or other readily-available remote sensing imagery to produce up-to-date and accurate maps of natural vegetative cover and existing land uses, along with reliable data on deforestation rates. Distribute these data widely to relevant government agencies; also make them available to the public.

12. Export and Import Policies:

- a. Avoid subsidizing or otherwise promoting beef exports from

countries where most beef is produced on induced pastures (at the expense of forests or other native woody vegetation).

b. Avoid import substitution or export promotion strategies for dairy products, except where produced in very intensive systems or on natural grazing lands.

13. "Cattle-free" Development Zones:

a. In forest frontier areas, prohibit transportation of large numbers of cattle to promote more forest-conserving development options, such as perennial or tree crops, various agroforestry systems, small livestock, fisheries (including aquaculture), sustained-yield timber harvest, extraction of non-wood forest products (such as Brazil or other nuts, chicle, and wild rubber), and nature-oriented tourism.

14. Discourage Beef Consumption in Countries Lacking Natural Grazing Lands:

a. Use pricing policies to encourage both the production and consumption of alternative sources of animal protein.

b. Tax beef purchases to discourage both consumption and production.

15. Population Policy: Reducing population growth and (eventually) stabilizing population size will lessen all types of environmental stresses in the longer term, more than they will reduce deforestation or other threats to biodiversity in the short term. An "ideal" population policy in LAC countries would:

a. Promote the full possible range of contraceptive and family planning services (including legal abortion).

b. Provide financial or other (non-coercive) governmental incentives for families to have no more than two children.

c. Vigorously support other policies (such as girls' education) which indirectly result in smaller family sizes.

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TOWARD A MINIMUM-DAMAGE APPROACH TO DEVELOPMENT ACTIVITIES IN TROPICAL RAINFORESTS

Douglas McMeekin
January, 1992

Introduction

- The context of this paper
- The need for a pragmatic approach to development activities in tropical rainforests.
- The examples presented below are based on oil exploration and extraction in the Amazonian rainforest, but can be applied to other activities in other fragile tropical areas around the world.

Seismic Exploration

- Notes on the nature of seismic exploration, its methods and practices (surveyed lines; helipads; use of drilling equipment; dynamite charges; geophones/geosensing to analyze substructure) and their impact on tropical forest environments.
- Cutting and clearing lines: usual methods, damage-limitation techniques and precautions
- Helipads: damage minimization
- Protection of streams
- Impact of seismic crews: sources of problems and approaches to control: hunting, impact on local cultures, extraction and sale of animal and other tropical products.

Choice of Well Sites (Exploratory and Production Wells)

- Relation to rivers and streams
- Relation to mountain slopes and drainage patterns
- Relation to traditional villages
- Access alternatives: road, river, helicopter access, pipelines

Dealing with Local People

- Mobility of forest people and their unexpected proximity
- Communication:
 - Begin communication early; well before development
 - Communication mode: request permission rather than announce arrival
 - Choice of representative: temperament, sensitivity, listening, sharing in and respecting local culture
- Employment of local people during all phases of development
- Establishing compensation levels: between exploitation and creation of impossible expectations; welfare activities

- Impact on health conditions: possible problems and ways of minimizing risk; role of communication; follow-up and monitoring of health conditions
- Long term impact of development on local communities: developmental vs. "expedient" interventions; long term economic viability; impact on women's production and role in development

Environmental Impact Studies

- Early strategic decision on whether area should receive special protection efforts (if so, focus on protection rather than base-line studies)
- Practical EISs: objective/outcome: recommendations on ways to mitigate negative effects
- Use of studies as basis for impact monitoring: Edaphic fauna, fish, other vulnerable species & indicators
- Need for archeological scans and studies.

Using Clearing Activities as Opportunities for Scientific Studies

- The concept: if trees must be felled, allow scientists access to the flora and fauna of the otherwise-unreachable canopy
- Value of scientific studies:
 - Scientific advance; better knowledge of tropical rainforest; discovery of species new to science
 - Cooperative studies can bring leading scientists in a variety of fields; promote wider dissemination of findings; provide training and experience for local scientists; co-authorship opportunities for national scientists
 - Public relations benefits
- Coordination with national and international institutions
 - Establishing contacts; rights and contracts
 - Arranging logistics; foreseeable problems than can sometimes be avoided
 - Obtaining national permits to collect and to export specimens
- Equipment and support needed by scientific collection teams
- Involvement of non-scientific workers in support of teams: benefits of involvement (e.g.: training) and precautions
- Study results: orientation toward feedback that will promote resource protection and sustainable development

Construction Techniques

- Forest clearing for platform construction: Limit and control the area that must be cleared; pull leaning trees inward toward cleared area; keep surrounding forest clean
- Lumber supply: minimize number of boards; use downed trees fully
- Chain sawing techniques: possible 25 percent productivity increase

- Collection and transport of boards: costs and benefits of helicopter vs. dozer and sled
- Timber selection: obtain indigenous populations's participation
- Construction camp:
 - Site selection criteria
 - Water supply, sanitation, access
 - Minimizing cleared area and providing for regrowth
- Excavation:
 - Search for archeological remains
 - Earth storage: plan in advance; avoid blocking streams; push in limited number of directions and areas; utilize helicopter approach paths; try to minimize long-term negative impact
- Topsoil: Determine volume before excavation begins; bulldozer techniques for collecting; dealing with stumps; stockpile protection
- Erosion Control:
 - Complete clearance of fill areas (avoid standing trees or material that permits slippage)
 - Anticipate volume and direction of erosion flows
 - Terrace if possible for easier regeneration
 - Use of geotextiles, gutters on banks
 - Use of grasses: conserve original species [is that what you meant by "make bales of grass"?]; selection of species to re-cover and reduce erosion
- Water pump placement and operation:
 - Choice of site to minimize negative impact
 - Site clearing and preparation: desirability of hand-clearing
 - Minimize stream encroachment
 - Water-line placement by hand along easily-eroded routes
 - Berming and lining cleared areas
 - Fuel and oil for the pump: storage; security; oil changing and disposal of used oil
- Use and protection of small streams:
 - Determine where protection is needed at the outset and incorporate protective measures in site design
 - Provision for later removal and reclamation of dam sites, if needed
 - Pumping water to use facilities remote from stream to minimize damage
 - Use of degradable soaps and other products
- Solid waste disposal:
 - Latrines: early construction; siting; toilet paper
 - Covering and composting biodegradable solid waste
 - Removal of non-biodegradable waste (risks to indigenous populations; special care with medical waste, toxic waste)
- Reserve pit construction, operation and reclamation:
 - Preferability of cuts rather than fill areas
 - Design to avoid surface water run-in
 - Lining with geotextiles
 - Avoidance of foreign matter (reasons)

- Treatment and/or reinjection
- Removal of geotextile
- Store drilling mud in "farms"
- Backfilling
- Burn pit placement:
- Rig wash water and overflow: (reasons overflow occurs)
 - Oil/water separator design (sources of hydraulic and engine oil)
 - Techniques for keeping system clean
- Nurseries: Design; selection and propagation of local species
- Examples:
 - Choice of antenna design required mining gravel; resulted in unnecessary stream damage: costs and benefits of alternatives
 - Use of Shurpa cranes required doubling platform size (inapplicability of designs and TA from other regions)

Road Construction:

- Background special impact of roads (block migrations; colonization potential; potential amount of acreage lost)
- Road width and clearing required (numerical example of potential saving in acreage cleared): planning; vehicle use and requirements; temporary vs. semi-permanent use
- Excavation techniques: difficulties and advantages of keeping dozers in right-of-way
- New geogrids
- Use of gravel: impact of mining: damage to streams. Alternative materials; costs and benefits
- Use of drainage pipes; impact of damming streams
- Bridges: design; location of supports; dredging
- Fill areas: avoidance of unanticipated blockage and damming effects
- Stream crossing methods to minimize impact
- Gravel mining: techniques to minimize stream damage
- Road maintenance: environmental damage from use of old oil on surface
- Planning for pipeline (contingencies; avoid costs of premature clearing)
- Control of access roads:
 - Military control
 - Control by indigenous people (incentives)

Pipeline Construction: special considerations that differ from road construction

Pipeline Maintenance:

Reclamation:

- Seeding; seedling planting
- Distribution of topsoil
- Seed bank; collection from local trees
- Vines
- Weirs to aid in moisture retention, provide shade
- Documenting regrowth

Environmental Guidelines:

- Clear communication to workers (in own language)
- Hunting; collection, purchase, transportation and sale of animal products
- Archeological sites and artifacts
- Mineral products (gold)
- Other provisions (reasonable care)
- Sanctions (monitoring, enforceability, credibility)

Development of Alternative Products:

- The challenge of developing sustainable use of tropical forests
- The critical role of markets and marketing
- Special needs of indigenous peoples for earning capacity without either undermining culture or destroying the ecosystem on which the culture has depended
- Example: Efforts to develop pharmaceutical product:
 - Problems with bureaucracy and regulations
 - Problems of perceptions on the part of critics
 - Product development challenges: developing both demand and supply

Conclusions

CHAPTER I. SEISMIC OPERATIONS

The first step in determining whether an area is suitable for oil exploration is to carry out a seismic program. The results of seismic testing will indicate the area's subterranean structure, identifying structures associated with the presence of oil.

Very generally, a seismic program consists surveying a grid of lines, if necessary, as in the case of a tropical forest, clearing these lines sufficiently to bring in portable drilling equipment, placing dynamite charges in the bottom, installing geophones, very sensitive devices used to record shock waves on the surface, finally detonating the dynamite. The geophones pick up the vibrations, or the echo, into the subterranean structure. All this information is then processed by computer, and a print-out is produced showing all the various strata to thousands of feet in depth. An oil company utilizes this information to determine if there are subterranean structures which indicate the possible presence of oil.

It is not simple to undertake a seismic program in a tropical forest. Such a program involves logistical problems such as clearing the grid lines, bringing in equipment, and management of personnel. In the Ecuadorian Amazon, a seismic program may employ up to 400 workers in the field at one time.

Unfortunately, many companies tend to feel that a seismic program does not have a major impact on the environment. In fact, the opposite is true. A seismic program may potentially have one of the most severe environmental impacts of the entire exploration program. This is due to the large numbers of personnel moving over an area of up to half a million acres, working on a one to two kilometer grid, cutting trails, bringing in equipment, clearing of helipads, helicopters supporting the operation. All of this activity has a major impact on the wildlife and the indigenous inhabitants in the area. The grid pattern gives animals no place to go to flee the activities, the larger animals especially tend to be cornered by the activities. The impact on game affects indigenous residents; and village life can also be disrupted by personnel in the area if precautions aren't taken.

The environmental impact resulting from a seismic program is over a large geographic area, but has a relatively short duration. There are ways that the negative impact of a seismic program can be mitigated. First and foremost the attitude that the operation does not cause any environmental damage which typifies both oil company executives and seismic company operators must be changed. Oil companies should include either in-house or outside consultants (on what ???)

in the writing of the contract with the seismic companies. An environmental person ??? must be on location in the field during the seismic program. Very strict rules concerning hunting, clearing activities, movement of personnel, control of trash disposal, and interaction with indigenous residents must be implemented. The environmental person on location needs to have the authority to dismiss employees that do not follow the environmental rules adopted by the company.

The contract with the seismic company must require that the company provide all of the food necessary for the men working in the field. It has been a common practice to furnish several workers with shotguns and shells to hunt for food. Locals, often Indians, employed in the operation usually prefer the hunted game over the beef or canned tuna that may be brought in. However, hunting to supply food for 400 people, spread out over the vast area that a seismic program encompasses, can have a major impact on game in the area.

The rule on food needs to be strictly followed. There needs to be a clear understanding on the part of all persons involved that employees who do not follow the environmental rules will be dismissed immediately. The oil company and the seismic company need to support any such decision.

If an area where a seismic program is being undertaken does not have road access, then all logistical support must be done by helicopter, or in some cases, by canoe. In the case of a helicopter operation, the company usually selects a village for use as a base of operations. This village generally has an airstrip, which the company often lengthens to accommodate larger supply planes. A seismic company may construct some temporary huts, usually of plastic or canvas, to house crew at the base. Sometimes a company will request permission from the village to use schoolhouses, community houses, or other such buildings to house crew while they are there.

When a program begins working out of a village, at first the villagers seem to like it. There is a lot of activity, it's providing employment for their men, the children like the helicopters, but after a while, this begins to wane. It's important that both the oil and seismic companies be aware of the strain that a seismic program can have on indigenous residents unaccustomed to the noise, pollution, dust and large numbers of people associated with the program.

Many times, the improvements made by the company ultimately benefit the village, as in the case of installation of better water systems, better sanitary facilities, and so on.

For a helicopter-supported operation, helipads are usually cleared every two kilometers along the lines, permitting the helicopter to bring in portable drilling equipment and other

necessary supplies. The helipads are small, quickly cleared with chainsaws and machetes. Only trees are cut, and no topsoil is removed. The small helipads tend to be located either on ridge tops or flat areas close to streams.

It is common for the trees felled to clear the helipad areas to be allowed to fall any which way. In the case of helipads located alongside streams, the trees often fall into the stream, blocking it, particularly if it is small. This practice should be avoided. The trees next to the stream should be cut so that they can be hauled out of the stream or felled into the clearing, so that they don't fall into the waterway. Since the topsoil remains undisturbed, the helipad areas regenerate very quickly without the need of any intervention. Within eight to ten months after use of the helipad has ceased, these areas exhibit vegetation one to two meters high. Within two years, they have trees four to five meters in height.

When the survey lines are cut, every effort should be made to keep the lines as narrow as possible. In most cases, these lines should not be more than two meters wide. This is sufficient for bringing in the portable, hand-carried drilling equipment and to string the lines for detonation of the dynamite and the geophones. Seismic activities should be avoided near areas supporting human settlements, and especially near their gardens.

There has been considerable debate and criticism of the oil companies that the detonation of the dynamite destroys habitats and runs the game off, etc. My own personal observation is that the dynamite blasts occur twenty to thirty meters below the surface in holes from ninety to one hundred meters apart; there is a single boom which can be felt, but is not a major explosion. I don't feel that the detonation of the dynamite presents an environmental problem.

Seismic holes are not placed in rivers or lakes. It is not feasible to drill a hole with the equipment used in the middle of a lake or river. Thus there is no dynamiting in streams or lakes.

One of the most problematic issues is controlling men taking shotguns into the field. Natives to the area employed in the operation traditionally hunt the forest, own shotguns, and like to carry them. The company needs to make it very clear that no one is permitted to have a firearm of any type, and anyone found with a firearm will be dismissed immediately.

It's also important that the company strictly control the collection of animals and animal products by workers. Spread out over a large expanse of area, it's very easy for them to find baby animals or cut down a tree with a nest and get baby parrots or baby monkeys if they can shoot the mother, or the

skins of larger animals. This is an additional source of income, but is a major environmental problem. There needs to be someone in charge of controlling this in the field. This can be done in a couple of ways. One is to have an environmental officer in the field during the entire seismic operation, someone who's not inclined to go along with everything the company wants, and who will be looking for workers trying to smuggle out animal products or animals, and who has the authority to fire someone. The second thing is to try and get the helicopter pilots to cooperate in not transporting any passengers carrying animals or animal products. This can be difficult to achieve since pilots in many cases are nationals and not highly sensitized to environmental issues. Of course, if they knew that they would lose their job if they transport animals or animal products, they might take more interest.

There have been occasions in which a seismic company has provided its workers with mattresses used in other locations. Approximately twenty years ago in Ecuador, a seismic company working with one of the first oil companies operating the country used mattresses that had been utilized by others and contracted a number of Huaorani Indians to work in the seismic program. The Indians caught scabies, and to this day they still have a scabies problem. This could have been avoided, and in the future must be avoided by insisting that mattresses be fumigated before use by a new crew.

The helipad areas have always intrigued me because of their potential for use in scientific studies. No one has ever come back and done a regeneration study to see what species come back naturally, what insect or bird or rodent populations might move into these clearings. They offer a unique opportunity to do a series of studies over a period of years to document the regeneration dynamics. These small helipad areas measuring approximately half an acre are the same type of clearing created by small landslides or cyclone-type winds that flatten the forest in different areas. They are easily accessible along a defined line, and cross many different micro-habitat conditions. I once went into a helipad area that was already beginning to grow up, although we could still land the helicopter, many months after the conclusion of all operations. The area was within thirty meters of a fairly large river, but the river was blocked at the lower end by the fallen trees, making it unnavigable from the downstream direction. The area was sufficiently remote that since the conclusion of operations no one had been there. It was during the dry season and the river was lower. It was during the breeding season for the large river turtles which can reach two feet across. When I walked down to the river, it was black and with these turtles floating in the water sunning themselves. You could have walked across the river on their backs. There were literally thousands of them. This was a very rare sight, because in most areas

accessible to humans, the indigenous inhabitants and *colonos* (mestizo migrants from other regions of the country) have collected or hunted these animals, almost to the point of extinction in some areas.

One time I visited a Huaorani family living in an extremely remote region of the Yasuní River. They were semi-nomadic, so it was difficult to pinpoint their location at any given time. They tend to move approximately every three months, constructing shelter at the new site, planting a garden, and then moving on later, either to a previously used or completely new site. In this case, we had to search for a house with human activity. We found the house by helicopter, but there was no place to land, so the pilot had to place the front skids of the Bell 206 on the river bank and hold the helicopter in a hover while we unloaded our gear. His final instruction to us before lifting off was "I hope you can find a better place for me to land when I come back." We spent several days there, during which time the Indians happened to be clearing land for a garden. We decided to take advantage of the clearing for the garden for an improvised helipad. One of the young men, about 19 or 20 years old, had worked for one of the seismic companies. When the garden area had been cleared and we had selected a small 4 meter square area for the helipad, removing all logs, this young man took four poles which he cleaned with a machete and laid them in a square around the area, and then took some smaller sticks, assembling them at one side of the area enclosed by the poles. It was very interesting, because here was a young man who didn't speak Spanish, illiterate, but who knew that this was the way in which helipads were arranged in seismic operations. The seismic company typically set up a helipad area as a square enclosed by four poles, with a series of smaller sticks to one side used for numbering the area.

Chapter II. Environmental Impact Studies

Companies, whether national or international, who wish to engage in exploration activities in the tropical forest are frequently required to first complete an environmental impact study. These studies are often required by law through the Ministry of Energy and Mines.

Unfortunately, in many cases, studies required are unrelated to the protection of the environment. In other cases, the information required is so unwieldy as to be impossible to gather. For example, the Ecuadorian government requires biomass and energy transfer studies prior to undertaking oil exploration. Such studies are highly complex, extremely lengthy, very expensive, virtually possible to complete in remote tropical forest locations, and have nothing to do with measuring and minimizing environmental impact. Also, base line studies *** of what? are frequently required. Without

question, base line information is very valuable, but needs analysis and follow-up studies in order to yield its full potential, and these follow-up studies are almost never done.

Indeed, the first step is to examine the area and decide if it is worth protecting *** criteria? If so, then studies need to be done which will accurately measure environmental impact as well as clearly show ways of minimizing damage caused by the operation. Companies should make every effort to impress the importance of practical and rationally selected studies on the local government *** what local government and the Ministry of Energy.

In fact, it is necessary that companies undertake only a few studies, as long as they are appropriately selected. One of the most important is a base line study of fish in streams located near the drilling or mining operation prior to the commencement of any activities. It is imperative that such a study be followed up after the completion of operations to see if there are any changes in the aquatic populations' health or physical condition. Base line and follow-up studies of fish populations should look primarily at water conditions, gill structure, reproductive condition, and feeding habits. *** check previous sentence for accuracy. Species composition may not give a completely clear picture of impact due to of species at different times of the year. In the case of a drilling operation, six to eight months may pass between the initial and follow-up study, during which time species composition may change naturally as a result of migration patterns.

Edaphic fauna are also extremely useful as an indicator of the degree of ecological degradation or recuperation. Edaphic fauna are the micro-organisms that live in the soil and are highly vulnerable to compacting, vibration and the least change in shade, humidity, and sunlight. Additionally, they also have very short life cycles and so population changes can be measured over a relatively brief period of time. *** at what point does it make sense to lay out the nitty gritty details of how to do these studies? sample plots; time and manner of collection; compilation of data; follow-up

*** it doesn't seem to me that this paragraph goes with this chapter. We have done a number of edaphic studies gathering base line data over approximately two and a half million acres in the Ecuadorian Amazon. As a result of these studies, we are now aware that areas which visually seem to be impacted in many cases have completely returned to a normal hierarchy of edaphic fauna. Healthy soil and balanced microorganism populations are two very strong indications that an impacted area has basically recuperated. The presence of pioneer species alone should not be used as a determining factor when judging the degree of degradation or

recuperation exhibited by an impacted site. Indeed, pioneer species appear as a matter of course after earthslides and other natural disturbances, so their presence is not an automatic indication of ongoing impact. Finally, trees are not a good bioindicator of impact and recovery because of their much longer life cycle.

Finally, archaeological studies have proven to be very important in tropical areas. In 1990, I was at a well location where bulldozers were clearing the site and noticed large quantities of broken pottery lying around. I picked up some diagnostic pieces and brought them back, later getting in touch with an archaeologist. As a result of that discovery, we've started making archaeological surveys at all well locations prior to the beginning of operations whenever possible. Prior to this, only three archaeological excavations had been done in the Ecuadorian Amazon, all along rivers. These sites were easy to reach by canoe and the pottery was generally found sticking out of the river banks. No one really suspected that there had been much human occupation on ridge tops, in some cases long distances from rivers. The discovery made at the Ramirez well location has prompted us to look at seven different well locations and out of the seven, five have yielded archaeological material. This is surely indicative of widespread human occupation of the entire Amazonian region in prehistoric times, given the random location of oil drilling operations.

CONSTRUCTION PHASE:

TECHNIQUES

AND

SUGGESTIONS

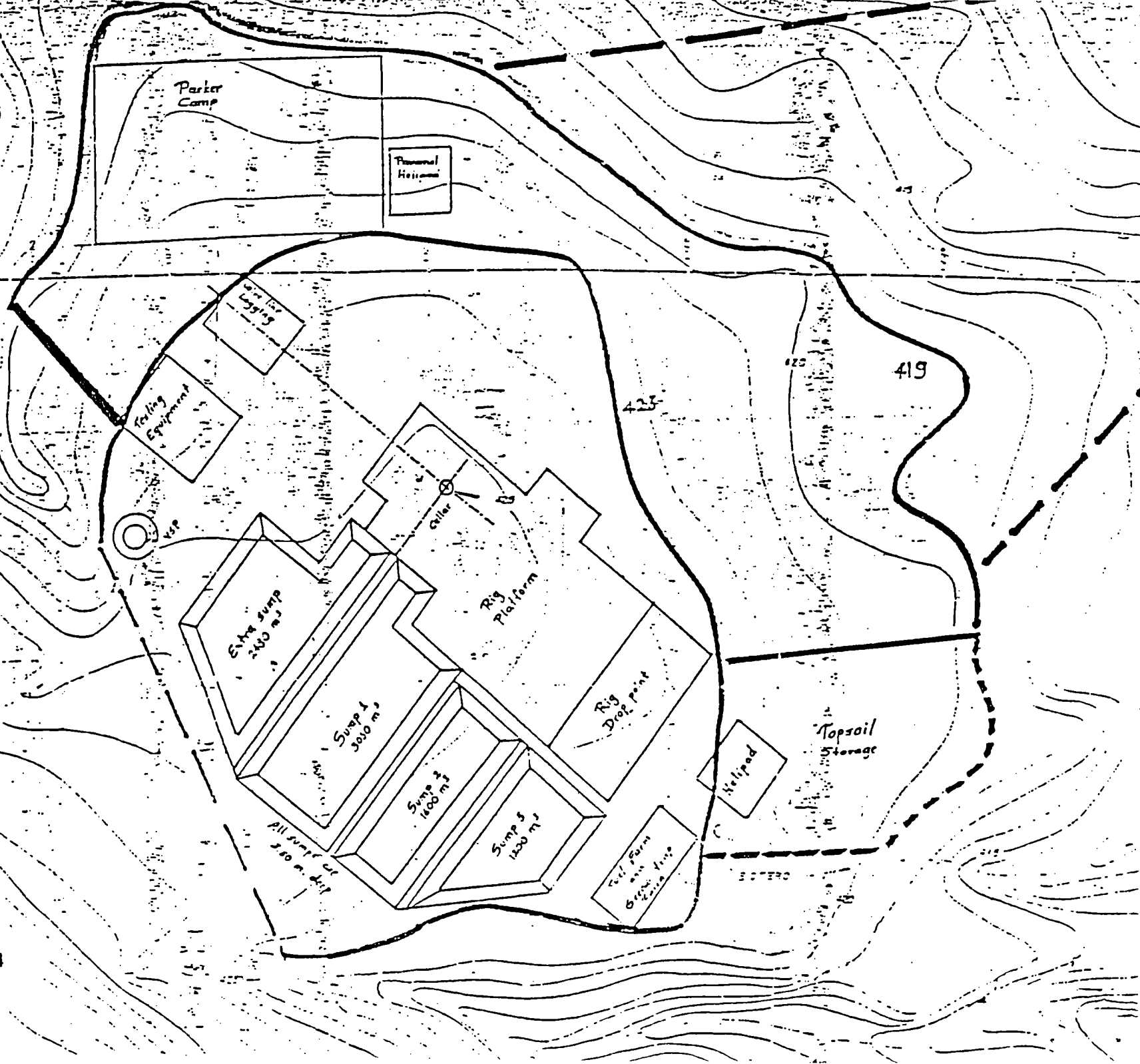
TIMBER SELECTION TECHNIQUES

At its Moretecocha location, Arco was the first oil company operating in Ecuador to consult with the local Indians regarding selection of the trees that the company needed for boards prior to their being cut. The example set at Moretecocha needs to be followed at the Villano location. At Moretecocha, foresters, a construction foreman, one or two chainsaw operators and several Indians went to areas preselected by the Indians for the sourcing of boards. The Indians indicated which of the trees they were willing to have cut, reserving certain species because of their value, primarily for constructing dugout canoes. These trees were marked so they would not be cut later by mistake. ARCO made the decision to transport all of the boards from where they were cut to the platform by helicopter. This eliminated the traditional practice of using a bulldozer to collect the boards from the forest, which is very damaging to the environment.

FOREST CLEARING FOR PLATFORM CONSTRUCTION

The Villano site is located on a natural bench on the side of a hill with sufficient area for the platform (Map 4). Additional trees will need to be cut to clear an approach way for the helicopters bringing in the rig equipment and supplies. The platform and camp area will require clearing

MAP 4



and bulldozing approximately two hectares (5 acres); the approach area will require cutting an additional hectare (2.5 acres), but no bulldozer activity will be necessary. All of the leaf litter, seed sources, and brush and branches to provide shade will be left intact in the helicopter approach area, resulting in rapid, unaided, regrowth. A number of trees in the areas to be cut can be sawn into boards or timbers for use in construction of the platform or sleepers for the campers to sit on. All usable material should be utilized, thereby reducing the number of trees in other areas that have to be cut and saving helicopter time to transport boards.

Trees left standing around the cleared sections will serve as a source of both seeds and organic material for the area. Careful clearing techniques will ensure these trees remain standing and in healthy condition.

LUMBER SUPPLY

The potential lumber supply available at the Villano site is much better, both in terms of quantity and quality, than that available around the Moretecococha 1 well site. The survey team reviewed all of the areas within a reasonable distance of the Villano 2 location to determine the best areas for cutting trees for use as boards. The ideal area for logging is along the southern flood plain of the Lliquino River, 3/4

to 1 km. (0.4 to 0.6 miles) distant from the platform site, where suitably large trees grow in abundance. Cutting in this area will cause the least environmental damage. The area is relatively flat, reducing erosion and damage to the forest as trees are felled. (On steep slopes, trees tend to fall and then slide, knocking down additional trees). The majority of the tree species are fast-growing soft wood varieties. There is a deep organic layer of soil that will aid in natural regeneration. Harvesting this area alone should supply all the boards needed for construction purposes. The Indians from Pandanuque also preferred this region for logging.

CHAIN SAWING

All of the board cutting is done with conventional hand-held chainsaws. The boards are cut at the location where the tree is felled. The operators are highly skilled and do not use mechanical guides to aid them in cutting straight boards, instead marking a straight line with a string soaked in oil and cutting from that line. They use conventional chains for their saws but file off the drag links which allows the chain to cut more quickly with the grain of the wood and prevents kick-back of the saws.

The men operating the chainsaws are paid by the number of boards they cut per day, providing little incentive for them

to utilize each tree as fully as possible. At Moretecocha, a D.T.M. forester worked with the chainsaw crews to achieve better utilization of each tree cut. The results were significant. The average increase in yield of boards per tree was approximately 25% over what has traditionally been produced. This success, though, was due to the unwavering support of ARCO Oriente and the contractor Phillips Construction, and the threat of dismissal of any chainsaw team that did not follow the environmental measures adopted by the company.

The following are just two examples of how detailed supervision during the logging phase can increase the yield per tree and reduce the operation's environmental impact. Supervision can enforce the utilization of the upper sections of the tree trunk, which are often harder to get at because of broken branches, vines and smaller trees that may have been pulled down with this part of the tree. It takes some time to clear this section of the trunk so it can be sawn up for boards.

The majority of the boards usually measure 0.05 x 0.25 x 2.5 meters (2 in. x 10 in. x 8 ft.). Other companies generally don't use boards with wane (bark) on two edges in their operations. However, much of the construction around a platform involves building walkways or decking three or four

boards thick, for which the presence of a small amount of bark does not present any structural problems.

COLLECTION AND TRANSPORT OF BOARDS

All boards should be transported from the forest either by helicopter or by hand, absolutely never by bulldozer. This method yielded extremely positive results at the Moretecocha location. At Moretecocha, the round trip time for a helicopter to make a pick up of boards ranged from 2 minutes and 15 seconds to 3 minutes and 50 seconds. Depending on the size of the helicopter, either 30 or 100 boards can be transported each trip.

CONSTRUCTION CAMP

The original survey team cleared a small area for their temporary camp approximately 150 meters (500 ft.) to the northeast of the platform site and 30 meters (100 ft.) from a small helicopter pad. This clearing is large enough to accommodate the construction camp.

There are several advantages in locating the construction camp in the existing clearing. To clear a totally new area would cause environmental damage. The helipad used to bring in crews and food during the construction phase is quite close by. The location is away from the small stream next to

the platform that has permanent aquatic life, minimizing impact to the stream.

However, the site is approximately 150 meters (500 ft.) from the platform, whereas an alternate site would be only 50 meters (160 ft.) distant. There is also no nearby water source, although this problem can be easily solved as will be explained later.

Given the relative advantages and disadvantages, the existing clearing is recommended for establishing the construction camp. Water supply and sewage disposal for the camp are discussed later in this report.

EXCAVATION

The platform site is relatively flat and will require earth excavation to only a few meters in depth. Precautions similar to those taken during the construction of the Moretecocha location will need to be followed. These include:

1. Marking the area to be bulldozed prior to initiating any tree cutting or excavation. All tractor activity must be kept strictly within these boundaries.

2. Ensuring that no brush, trees or dirt are pushed outside of the marked boundary and that any trees that could potentially fall outside the area be pulled in with a cable.

TOPSOIL

During the construction of the Moretecocha location, topsoil from the platform area was collected by bulldozer and stockpiled to be redistributed over the disturbed area during the reclamation phase. Based on the Moretecocha experience, it would have been useful to have known the depth and general fertility of the topsoil prior to excavation. To obtain this information at the Villano site, soil samples were taken from nine points in the area of the proposed platform. (See map 5 in Appendix IV.) At each of the nine points, test holes were dug 40 cm. square by 40 cm. deep (16 in x 16 in. deep). Samples were taken approximately every 10 cm. (4 in.).

Analysis of the samples provided an indication of the thickness of the organic layer, which will permit greater accuracy when removing the topsoil. The organic material will then be stockpiled for distribution during the reclamation phase following the completion of drilling activities.

The present construction plan calls for making the cut in the platform area and pushing the fill to the north. The spoil area is not extremely steep, making it possible to remove and stockpile the topsoil prior to pushing the fill dirt over the area. As much organic layer as possible needs to be collected since it is not very thick and will be needed for the reclamation phase.

Collecting the topsoil will be done by bulldozer. As mentioned earlier, the organic layer is only about 20 cm. (8 in.) thick. The bulldozer operators need to be instructed not to dig out stumps of any size as they collect the topsoil since the action of grubbing out a stump requires digging below the topsoil. Additionally, the cleats on the bulldozer tracks quickly penetrate the thin organic layer. The resultant churning of the soil quickly reaches the clay layer, and the upper layer is basically lost. By simply collecting the topsoil and avoiding the stumps, they will be able to gather the maximum amount of organic material.

After the topsoil has been stockpiled, it must be covered with geotextile. The stored topsoil at Moretecocha was not covered and became thoroughly saturated from the rains, making it extremely difficult to work with when the reclamation work began. Plastic is not a suitable cover because it is too light and tends to be blown off by the down draft of the helicopters.

It would be helpful if small logs and large branches were removed from the bulldozed topsoil before storage. At Moretecocha, the logs and branches that had been gathered up with the topsoil created difficulties in trying to distribute the soil evenly over the disturbed area. It would be advisable that at least one bulldozer have a winch.

EROSION CONTROL

The excavation will begin after the topsoil has been removed and stockpiled. At the Villano site, only about three meters (10 ft.) will need to be cut to obtain the level area needed for the platform. The spoil should be pushed to the north to take advantage of the area where trees will need to be cut for the helicopter approach. The slope where the spoil will be pushed is not very steep, so there will be fewer problems with slippage of the fill than at Moretecocha. Ideally the fill should be contour-terraced with the bulldozer to aid in future reclamation.

It will be necessary to cut the trees in the fill area and clear all branches and brush to achieve good adhesion between the fill dirt and the natural slope of the land. The stumps of all trees cut in this area should be left sticking up a meter or less, depending on the depth of the fill, to stabilize the fill dirt.

The Villano area receives between four and six meters (20 ft.) of rain per year. (Moretecocha received four meters (13 ft.) in the first six months of 1991, but it was an unusually wet period.) Some erosion of the fill is going to occur and little can be done to prevent it. However, there are two techniques that have not been tried before which might help retard runoff and erosion.

1. In the absence of hay bales in the region that could be placed to retard erosion, it is suggested that local Indians be contracted to cut long grass and tie it into large bundles to serve the same purpose. These bales would then be placed at the bottom of the fill areas to help prevent eroded soil from entering the drainage-ways. There are various species of saplings in the forest that can be used for staking the bales that will sprout once they are placed in the ground. The stakes will keep the bales from washing away and at the same time form a living barrier. As the bales rot, they will provide organic material to assist in the regeneration.
2. Landscape netting, which is often used along road construction in the United States, could also be tried. The netting would have to be imported from the U.S., which would require adequate lead time. It would also probably cost more than the labor to make the bales, and

it is not certain that it would be significantly more effective.

WATER PUMP PLACEMENT

The pump that will provide the water for all of the drilling and camp operations will need to be located on the Lliquino River, approximately 1 km. (.6 miles) to the north of and 150 meters (500 ft.) below the platform location. The most likely site for the placement of the pump is a slight rise near the river. Local Indians informed the D.T.M. team that the Lliquino had not flooded the proposed pump location since 1974. (There has been unusually high rainfall in the region since the study team was on location, and it is not known if, as a result, the Lliquino flooded the pump site.) The pump platform must be designed to withstand flooding, even though the chances of flood levels reaching the site are slim.

The suggested pump location is on a slight bend of the river with a deep pool on the side closer to the pump. There is not enough curve to pose a threat of the river eroding the bank and undermining the pump. Dense vegetation at the river's edge constitutes a valuable buffer zone between the pump platform and the river. One large fig tree will need to be cut to provide space for the pump. All other vegetation is low, consisting largely of palms and bamboo.

The pump platform will have to be constructed out of wood to elevate it above the flood level. The pump and area for fuel bladders will need to be protected by an oil-water separator, the sides of which must be of wood or bermed earth. All bermed earth would have to be protected with geotextile to prevent erosion should the river flood. Potential flooding would consist of rising water rather than a swift current, due to the presence of heavy vegetation upstream from the pump location.

The terrain slopes gently down from the well platform to the water pump site. It is imperative that the water line connecting the two areas be laid by hand as was done at Moretecocha, and that a track not be constructed by bulldozer.

USE AND PROTECTION OF SMALL STREAMS

There is an extensive natural drainage system around the area of the platform consisting of a number of small permanent and semi-permanent streams. There are streams on three sides of the location of the proposed platform. During excavation for the platform site, it is important that a strip of vegetation at least five meters (15 ft.) wide be left between the semi-permanent streams and fill. These buffer strips will help reduce the amount of erosion that enters the drainage system from the bulldozed areas. The information

produced by the topographic survey team indicates that this is a feasible protection method.

During the construction phase, it will be necessary to establish a camp for the construction workers located away from the actual construction and tree cutting areas.

The proposed location for this camp is approximately 150 meters (500 ft.) to the northeast of the platform. Since this camp will be used prior to the installation of the permanent water system which will have a pump at the river, a system for providing drinking and washing water for the approximately 100 construction workers must be devised.

There is a small, deep ravine to the east of the platform area that has continuous water, even during dry periods.

This ravine contains boulders that form small pools.

Using the boulders already in the stream, it would be relatively easy to construct, by hand, a temporary dam, creating a catchment basin approximately 2 meters high by 3 meters wide (6 x 10 ft.). Very little movement of boulders would be necessary to form a dam high enough to collect sufficient water for the construction camp. To avoid using cement or other material that might contaminate the stream, we suggest lining the dam with geotextile to form a water-tight barrier. The geotextile would be easy to install and later remove when all activities are completed, leaving the stream in its original pristine condition.

If the above-outlined procedure is followed, the location of the pool would be higher than the site for the construction camp. A plastic hose could then be run from the pool to the camp, supplying the water by gravity, eliminating the need for a water pump next to the pool and thereby avoiding potential contamination of the stream with gasoline or oil. This system would require the installation of perhaps six plastic storage tanks at the construction camp to hold water since a gravity feed system is slower than a pump.

This particular stream possesses a sensitive ecosystem and therefore was included in the fish study. It is the only water course close to the platform location containing permanent aquatic life, and is the type of habitat that could well have endemic species. For these reasons, it is imperative that absolutely no earth movement occur within a minimum of 15 meters (50 ft.) of this stream. The topography is such that the normal runoff from the platform area should not drain into the stream. With proper planning, this small stream can be protected.

SEWAGE DISPOSAL

CONSTRUCTION CAMP:

Two latrine pits must be dug to accommodate the needs of the construction workers. At the construction camp for the Moretecocha well, the latrines were built approximately two

weeks after work began. This time delay is not acceptable! The human waste of 100 men scattered on the surface around the camp for any period of time poses a serious health hazard, particularly at present with the cholera epidemic. The latrines must be constructed before arrival of the full construction crew.

The latrines are built with lumber cut on location. Because it takes days to prepare sufficient lumber for the construction of the outhouses, together with all of the other tasks that need to be accomplished in the first days, we suggest that the holes for the latrines be dug on the very first day. Only a few boards are necessary to fashion the base and seat. Poles can then be installed around the base and plastic wrapped around them to provide privacy. Plastic can also be used for the roof. This will serve as an interim solution until sufficient boards are cut to build the more permanent facilities.

PERMANENT DRILLING CAMP:

A septic tank must be constructed to receive the sewage from the permanent camp's inhabitants. All digging for the tank must be done by hand. The dimensions of the tank at Moretecocha were sufficient. The interior will have to be lined with boards to keep the dirt from caving in. A wooden partition to collect the solids in approximately the first

third of the tank will have to be installed. The partition will need to be slightly higher than the discharge opening at the far end of the tank. The construction company is completely familiar with how to construct one of these septic tanks, although the partition was left out in the tank at Moretecocha.

The effluent line from the septic tank needs to transport the effluent a sufficient distance from the camp to avoid an odor problem. It is important to control the discharge so that it does not contaminate any of the streams, either near the platform or further downstream. On-site recommendations will need to be made when the final arrangement of the camp is complete.

SOLID WASTE DISPOSAL

KITCHEN AND CAMP:

The garbage from the kitchen needs to be divided into biodegradable and non-biodegradable waste. The biodegradable waste must be composted in holes dug some distance from the camp. A wooden top needs to be constructed over the compost pits to prevent rats, other animals, and flies from entering. This method of disposal of the biodegradable waste worked very well at the Moretecocha location.

The non-biodegradable waste that cannot or should not be burned needs to be collected and stored in large baskets that can be heli-transported from the well location back to the base camp. Again, this method was used successfully at Moretecocha. A net must be kept over the basket when it is transported by air to keep material from blowing out. Paper would be better burned in a small burn pit dug near the camp. It is not recommended that plastic bottles be incinerated because of the contaminants released.

DRILLING PLATFORM:

A hole dug near the drilling platform can be used to burn combustible waste. Its location must be determined in consultation with the Company Man. It must not be located close to any combustible material used for drilling, nor to the forest; and must not be affected by the down draft from the rotor blades of the helicopters.

This burn pit will be used to incinerate the empty chemical sacks and other combustible waste produced around the drilling platform. At Moretecocha, one man was designated to collect paper and trash around the platform and camp area. We suggest that the same procedure also be followed at Villano. One of the Parker Drilling tool pushers at the Moretecocha location commented that having the grounds

constantly cleaned helped provide an incentive to all of the workers to try and keep the platform area neat.

RESERVE PITS

Reserve pits for the drilling operation will need to be constructed, the size of which is determined by the National Directorate of Hydrocarbons. At Moretecocha, the pits were all lined with geotextile. The same procedure should be followed at Villano.

The most important environmental consideration for the Villano location is that the pits not be located too close to the base of the steep hill to the south of the platform. Any extensive excavation there could destabilize the bank and cause serious landslides that would affect the platform area. (See Map 6.)

During the first phase of the drilling operation, the production water will need to be treated prior to being discharged into the environment. At Moretecocha, this method was followed until the well reached a depth of approximately 2,000 feet (600 meters). At that point, it was possible to reinject the water into the annulus of the casing so no further discharge was necessary. The reinjection method worked very well at Moretecocha and should be repeated at Villano 2.

PREPARATION OF PLANTING HOLES

Tree seedlings will need to be planted in holes dug by hand and filled with a mixture of topsoil and fertilizer. The holes should be approximately 80 cm. square by 50 cm. deep (30 x 30 x 20 in. deep).

SEED BANK

Some of the most suitable tree species for revegetation (Balsa, Sangre de Drago and Guarumo) only produce seeds at certain times of the year. Many different species of tree seedlings can be utilized for revegetation, but in the case of these three species, seeds are best used. We recommend that seeds from these species be collected at the appropriate time of the year and then kept in refrigeration until needed for reclamation purposes.

WEIRS TO PROVIDE SHADE AND AID IN MOISTURE RETENTION

Boards torn up from the platform can be used to construct weirs measuring approximately 2.50 m (8 ft). For weir construction, four or five boards are nailed together to form two sides, across which other boards are nailed, leaving spaces equivalent to the width of a board. These weirs provide shade and aid in moisture retention, giving seedlings time to get established; they utilize boards that would

otherwise be thrown away; plants can grow up through the spaces; and the boards rot within a year, providing additional organic material.

REGROWTH DOCUMENTATION

It would be useful to document the growth rate of the planted and naturally occurring plants in the disturbed areas of the rig platform. At Moretecococha, D.T.M. has completed the first of a three-part study aimed at obtaining such documentation. In the study, two transects were established across the platform area. Every 25 meters (80 ft.), a 2 m (6 ft) test plot was marked off, and all of the plants in it were photographed, identified and measured. This study will be followed up at six and twelve months, providing detailed information on the rate of growth in the different micro-ecosystems of the platform area. We suggest that a similar study be carried out at the Villano 2 location when all drilling activity is completed.

ENVIRONMENTAL
GUIDELINES
FOR ALL
PERSONNEL

ANIMAL PRODUCTS

All personnel entering the location, for whatever reason, must be informed of the need to comply with all measures designed to protect and preserve the natural and human environment.

There will be no hunting, no fishing and no live wild animals kept on location. Absolutely no animal and plant products may be removed from the location. The purchase of Indian artifacts such as bowls, blow guns, and spears is permissible as long as they do not contain animal products (feathers, skin or teeth).

ARCHAEOLOGICAL ARTIFACTS AND SITES

The removal of prehistoric artifacts and the disturbance of archaeological sites around the platform location is forbidden.

GOLD MINING

The Lliquino River, which runs close to the platform, contains a relatively large amount of gold which is panned by the Indians from Pandanuque. This is their land and therefore their gold. Panning for gold by workers is

strictly prohibited. To do so would immediately create problems with the local Indian community.

GUIDELINES AND PROVISIONS
FOR DISMISSAL

ARCO Oriente has issued guidelines for operations within the tropical rainforest, which should be distributed to all contractors, with instructions for them to be made available to their employees in English and/or Spanish. At Moretecocha, ARCO dismissed any employee who violated these rules. The same policy should be adopted at Villano.

**PROCEEDINGS OF
THE FIRST INTERNATIONAL SYMPOSIUM ON**

**OIL AND GAS EXPLORATION
AND PRODUCTION
WASTE MANAGEMENT PRACTICES**

**SEPTEMBER 10 - 13, 1990
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MINIMIZING ENVIRONMENTAL PROBLEMS FROM PETROLEUM EXPLORATION AND DEVELOPMENT IN TROPICAL FOREST AREAS

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Introduction

Tropical forest areas are highly vulnerable to serious and often irreversible environmental damage from poorly-planned development activities. However, if the proper environmental measures are adopted and rigorously followed, petroleum exploration and development in tropical forest areas need not cause major environmental damage. Moreover, most of these environmental measures do not significantly increase petroleum production costs; some can even reduce costs.

This paper outlines the basic measures needed to minimize environmental impacts from onshore petroleum exploration and development in tropical forest areas. The paper is based on the author's experience with petroleum development in the Amazon region of South America; however, the recommendations provided here are likely to prove useful for petroleum work in tropical forested countries worldwide. The paper focuses on the most critical environmental issues involving petroleum exploration and development in tropical forest areas; it does not address certain lower-priority environmental problems (such as carbon dioxide emissions from the flaring of natural gas).

Oil companies can help ensure that environmental measures such as those outlined below are followed by codifying them (as specific policies and procedures) within an Environmental Manual. Such a Manual should specify the practices needed to minimize negative environmental impacts from each phase of petroleum development, including seismic investigations, exploratory and production drilling, pipelines, storage, refineries, and ports. The Manual should be detailed and explicit, so that it would be clear when contractors or employees are (or are not) following its rules.

Road Construction

In most tropical countries (particularly in Latin America), the most severe environmental impact from petroleum development is the colonization and deforestation that follows the penetration of forested areas by oil industry roads. Much of this colonization and deforestation takes place on lands which are unsuited for sustainable agricultural development. For example, recent unofficial estimates by a Bank mission in one Amazonian country indicate that, in the absence of specific measures to control colonization, each kilometer of new road built by the oil industry through forest results in the colonization of 400-2,400 hectares.

To minimize deforestation, oil companies therefore need to minimize the kilometers of new roads constructed within most forested areas. The layout of any new roads through forested areas should be carefully planned, to minimize their length. In some cases, the supplemental use of rivers for transporting supplies can reduce the kilometers of road built. Whenever economically feasible, exploratory drilling sites in forested areas should be reached by using helicopters, rather than by constructing access roads. Perhaps most importantly, new production drilling operations in forested areas should construct cluster drilling platforms (as Conoco plans to use in Ecuador's Yasuni National Park), rather than dispersed individual wells. This can greatly reduce the kilometers of new roads needed.

Prior to building new roads through forested areas with special legal protection (such as National Parks, Forest Reserves, or Indigenous Reserves), the responsible oil company should financially support a 24-hour roadblock and a regular system of patrols to prevent illegal colonization. This can be done through legal agreements with the relevant land management agency (Park Service, Forest Service, Agrarian Institute, or other agency). Locating the oil workers' camp just outside the entrance to the protected area can also help to deter colonization. Properly staffed roadblocks can also be used to control the transportation of illegally cut logs, wildlife products, or other contraband from the forest. After they are no longer needed (such as when petroleum reserves have been commercially depleted, or after unsuccessful exploratory drilling), roads built through unpopulated, forested zones should normally be decommissioned (such as by removing the bridges). This would greatly reduce future risks of colonization and deforestation in the area.

Environmental Manuals should specify maximum widths for various types of oil roads through forested areas. In some cases (especially in flat terrain), forest canopy cover can be maintained, so that the road need not be a barrier to the movements of monkeys and other arboreal wildlife. Environmental Manuals should also specify environmentally appropriate road construction materials and techniques in forested areas. Whenever possible, geo-textiles or geo-plastics (woven polyvinyl chloride or polypropylene) should be used as road construction support material,

because they reduce the requirements for timber and gravel. To the extent that any timber is used for the road base, it should come entirely (or as much as possible) from trees that are cut for the road right-of-way. For clearing the road right-of-way, trees should be felled with chainsaws rather than bulldozers. (Unlike chainsaws, bulldozers disturb the soil and tree roots; they also tend to damage many more trees outside the road right-of-way.) The Manuals should also indicate under which conditions gravel, heavy oil, or other materials can be used for road surfacing. (When oil is used for road surfacing, some of it washes away into streams; however, gravel mining disturbs river ecosystems.)

Roads constructed across streams should provide for proper drainage, such as through the use of pipe or box culverts. This is needed to avoid partially damming small streams, which blocks the migration of fish and other aquatic life, kills trees and increases mosquito habitat upstream of the road, and reduces water flow downstream. The culverts or other drainage systems require routine maintenance, so that they are not clogged with debris.

Some oil companies (both governmental and private) have "community relations funds", which are used to finance small-scale development projects in areas near the oil company facilities. These should not be used for building or improving roads through forested or legally protected areas. Rural roads financed through these special community programs should be subject to the same environmental criteria as roads planned for oil production purposes.

Management of Drilling Wastes

Spent drilling muds (which contain various toxic substances) should be landfilled in dry pits, or in sumps from which the water has been piped out. The landfill pits should be lined with a suitable substance (such as plastic) to minimize risks of groundwater contamination. The landfilling should take place before the site is abandoned, while on-site bulldozers are still available.

Formation water produced from drilling operations is oily, often extremely salty, and contains various toxic compounds. Whenever feasible, formation water should be reinjected into the ground. In any cases where this might not be feasible, the formation water that is not recycled (such as to formulate new drilling muds) should be treated on-site, prior to being discharged in adjacent waterways. Simple on-site treatments include aeration spraying or cascading for oxygenation and cooling, skimming of surface oil, flocculation and settling to remove certain salts, and dilution with fresh water. These treatments should also be used (as needed) for water piped out of oil sumps.

While they are in use (prior to eventual landfilling), oil sumps

(piscinas) should be screened from above with 2 cm (or finer) mesh nets, to prevent birds, mammals, and larger insects from entering the sump and being trapped and killed by the surface oil. Nets such as these are now legally required in parts of the United States; their cost is insignificant, relative to the costs of drilling each well.

Prevention and Control of Oil Spills

Environmental Manuals should specify design standards for any new pipelines for petroleum and its derivatives (as well as natural gas). These standards should indicate the proper spacing and types of valves and automatic shut-off mechanisms, to minimize damage from pipeline leaks. Pipelines should often be buried for environmental reasons--for example, to reduce forest clearing for the right-of-way, or to reduce risks of damage from vehicle crashes along highways. To the extent feasible, pipelines and their associated service roads should be re-routed around environmentally sensitive areas, such as National Parks and equivalent reserves.

Oil storage tanks need permanent earthen levees around them; the levees should be dimensioned such that they can contain all of the oil from the storage tanks, in case the latter should rupture. Refineries need appropriate water pollution control equipment, proper operational and maintenance procedures for this equipment, and staff who know how to operate and maintain the equipment. All infrastructure which holds petroleum or its derivatives (including pipelines, storage tanks, and refineries) should have a precise schedule of routine maintenance, including periodic replacement of parts, to minimize risks of spills or other malfunctions due to poor maintenance. Spent motor oil and similar wastes should be collected in barrels and burned or landfilled--not discharged into streams, rivers, or lakes. No washing of motor vehicles in streams and rivers should be permitted.

Strict adherence to these measures should minimize the frequency and magnitude of accidental oil spills. However, some accidental spills are inevitable (such as when Ecuador's main oil pipeline ruptured in 1987 after a massive earthquake and resulting landslides). It is therefore important for oil companies to develop Oil Spill Contingency Plans that encompass all of their pipelines, storage tanks, refineries, ports, and similar facilities. Contingency Plans should outline specific technologies and control systems, sites where control equipment and available personnel are to be based, an adequate budget and source of financing, the division of institutional responsibilities between the oil company and national and local Government agencies, and a schedule for rehearsal of oil spill containment and clean-up operations. Oil companies should also develop efficient administrative mechanisms for processing legal claims for economic damages resulting from oil spills.

Land Management at Petroleum Facilities

New camps built in forested areas should not use more land than is required for buildings, recreational purposes, and safety considerations. Some oil company camps in Latin America occupy many more hectares of once-forested land than necessary, due to their huge lawns and overly wide streets.

After drilling or other operations which involve land clearing or excavation are terminated, all cleared land should be rehabilitated. In humid tropical zones such as Amazonia, simply spreading out the soil which was originally scraped off during site preparation will generally promote rapid natural revegetation. In such cases, manual reforestation or other intensive landscaping are usually not needed.

In all types of petroleum exploration and development areas (including seismic study sites), all non-biodegradable solid wastes (such as plastics) should be deposited in small, on-site landfills. "Littering" with any such wastes should be strictly prohibited.

Managing the Activities of Oil Workers

All fishing (especially with dynamite or poisons) and hunting by oil workers should be strictly prohibited, because it greatly increases the local environmental impact of seismic studies or drilling activities. Oil companies and contractors therefore need to transport sufficient quantities of food to their workers.

Whenever possible, firearms should be completely prohibited from remote, forested oil exploration or production areas. In countries where guerilla groups are nonexistent, firearms are not needed for "protection". In those countries where a legitimate need for firearms may exist due to local political instability, pistols should be used (whenever possible) rather than rifles or shotguns (because they are less effective for hunting), and supplies of ammunition should be tightly controlled and monitored.

Mobility restrictions should be enforced for oil workers in forested or other environmentally sensitive areas. In particular, oil workers should not be allowed to stray from camp in areas anywhere near indigenous populations. Also, no alcohol should be permitted in such areas.

Oil companies should specify (within their Environmental or other Manuals) and implement appropriate occupational safety standards and procedures. The World Bank's Occupational Health and Safety Guidelines can be a useful reference in this regard.

Institutional Aspects

Effective institutional mechanisms are needed to ensure that the rules set forth in Environmental Manuals are actually followed in remote, forested areas. For example, bidding and contracting documents should explicitly outline all necessary environmental protection measures (as specified in the Environmental Manual). Financial penalties (large enough to serve as effective deterrents) should be specified for all violations of this Manual by contractors and concessionaires (including transnational oil companies). A transparent system of penalties (fines, suspension, or termination) should also be established for individual employees of oil companies or contractors, for each type of violation of the Environmental Manual.

Environmental Manuals are effective only to the extent that sufficient environmental staff are available to ensure their implementation. It is therefore important for oil companies to hire an adequate number of environmental staff, and to establish some type of in-house environmental unit. Environmental Manuals should indicate the number, specific duties, and necessary qualifications of on-site environmental control officers needed for each type of petroleum exploration and development activity, along with the approximate budget allocations needed to support these staff in the field. Besides operational activities, some staff should be responsible for routine, on-site environmental monitoring of water quality, aquatic life, and other environmental indicators.

To ensure that the environmental staff of petroleum companies are well-qualified to carry out their responsibilities, some type of environmental training is usually necessary. Environmental training options (which should be tailored to the specific needs of each oil company's environmental unit) include short, locally-organized courses on environmental assessment and mitigation; working as counterparts with environmental consultants on specific tasks (such as environmental impact studies of proposed new projects); participation in overseas special courses (such as those offered by the Center for Environmental Management and Planning of the University of Aberdeen, Scotland) or conferences (such as this symposium); and scholarships for master's or other degrees in environmental sciences at national or foreign universities.

Environmental Manuals should specify the legal framework (including laws, regulations, and administrative decrees) upon which they are based. Ideally, the Manuals should be public documents, and copies should be readily available to interested non-governmental organizations and members of the public.

In Ecuador, Petroecuador is currently preparing a comprehensive Environmental Manual for its operations, which take place largely in the ecologically sensitive Amazon region. After it is complete,

Petroecuador's Environmental Manual might possibly serve as a model for other petroleum companies interested in preparing or revising their own environmental manuals. However, each company's Environmental Manual will differ somewhat, depending on the host (or parent) country's environmental laws and institutions, the portfolio of activities undertaken by each oil company, and the types of ecosystems (forest or non-forest, onshore or offshore) in which petroleum exploration or development takes place.

The World Bank has recently adopted detailed policies on Environmental Assessment and Wildlands. The Environmental Assessment Policy requires that environmentally sensitive development projects have detailed environmental studies done prior to Bank financing, and that all feasible modifications be made in the project's design and operation to minimize any negative environmental effects. The Wildlands Policy seeks to minimize the elimination of wildlands (relatively unmodified natural ecosystems) in Bank-assisted projects, and requires the conservation of wildlands in certain types of projects. These policies are presently being implemented in a number of developing countries (including tropical forested ones) where the Bank is assisting the development of the petroleum and natural gas sector.

National Legal Strategies for Protected Areas Conservation and Management

**Papers Delivered at Workshop III.6
of the
IVth World Congress on National
Parks and Protected Areas**

**Caracas, Venezuela
February 1992**



The World Conservation Union
Union mondiale pour la nature

Environmental Law Centre
Centre du droit de l'environnement

Preface

The IVth World Congress on National Parks and Protected Areas was held in Caracas, Venezuela from 10 through 21 February 1992. This meeting of over 1500 conservationists from all disciplines, organised by IUCN, takes place every ten years. The IUCN Environmental Law Programme was involved in the parts of the Congress which dealt with the legal aspects of the conservation of protected areas. Assistance was given to the Workshop on International Law, while the Workshop on National Legal Strategies was organised by the IUCN Environmental Law Centre and directed by the Commission on Environmental Law Chairman, Dr. Parvez Hassan and the Deputy Chairman, Prof. Nicholas Robinson.

The Workshop III.6 on National Legal Strategies attracted approximately 70 widely diversified participants, with a total of 27 papers being presented. Most of these are reproduced, as they were presented, in this volume.

The Workshop had two goals. The first was to survey the global developments in the national legal strategies for the establishment and management of protected areas, including conventional land use restrictions, methods for securing local community participation, innovative non-site-specific conservation instruments and the integration of conservation and land use planning. The second, to consider successful legal techniques capable of broader application. The Workshop emphasised practical and implementable legal instruments and techniques, especially those which promoted public participation, respect for customary resource management practices and information dissemination. Environmental impact assessment was encouraged as a basic tool for the conservation of areas, while other innovative legal techniques, such as contractual agreements, easements, economic incentives and non-site measures, including the protection of habitat types were also brought to the forefront.

The Congress developed 20 Recommendations. The result of the legal presentations and discussions were encapsulated in Recommendation 4 which deals with international and national law. The Recommendation 4 has been reproduced as an annex to this collection.

The Parks Congress concluded that in light of the rising demands on the environment and anticipated global change, the natural and cultural assets contained in protected areas require even greater political commitment and financial support than in previous decades. Never before has there been greater concern among the world's peoples about environmental degradation, the loss of tropical forests, the contamination of our air, water, soil and seas and the decline in our biological wealth.

Françoise Burhenne-Guilmin
Susan Casey-Lefkowitz
IUCN Environmental Law Centre
November 1992

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Recommendation 4: Legal Regimes for Protected Areas

List of Participants

The World Bank's Wildlands Policy: A Tool for Incorporating Protected Areas Within the Design of Development Projects

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THE WORLD BANK'S WILDLANDS POLICY: A TOOL FOR INCORPORATING
PROTECTED AREAS WITHIN THE DESIGN OF DEVELOPMENT PROJECTS

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ABSTRACT: The World Bank's Wildlands Policy recognizes that the conservation of wildlands (relatively unmodified natural areas) needs to be incorporated within certain types of Bank-supported development projects. Under this policy, the Bank endeavors to ensure that projects are planned and implemented with due consideration for preserving biodiversity, as well as the wide variety of environmental services provided by wildlands. Since its adoption in June 1986, the Wildlands Policy has guided the design and implementation of a sizable number of projects in sectors that include agriculture, forestry, roads, hydroelectric power, water supply, oil and gas, and mining. This paper reviews some notable successes in the Bank's application of the Wildlands Policy, presents some of the lessons learned from project implementation, and indicates measures which are being taken to improve future success. The Wildlands Policy complements several of the Bank's other environmental initiatives, including (a) our operational directive on Environmental Assessment procedures and (b) the Global Environmental Facility, which will finance biodiversity conservation activities which are additional to those required as environmental mitigation by the Wildlands Policy.

SINTESIS: La Política de Areas Silvestres del Banco Mundial (BM) reconoce que la conservación de areas silvestres (areas naturales relativamente sin modificar) debe ser incorporada dentro de ciertos tipos de proyectos de desarrollo apoyados por el Banco. Bajo esta política, el BM se esfuerza por asegurar que los proyectos sean planeados e implementados, tomando debida cuenta de la preservación de la biodiversidad, así como la gran variedad de servicios ambientales que proveen las areas silvestres. Desde su adopción en junio de 1986, la Política de Areas Silvestres ha conducido el diseño y la implementación de un numero considerable de proyectos en los sectores agrícola, forestal, carretero, hidroeléctrico, de dotación de aguas, minero, y del petróleo y del gas. Esta ponencia revisa algunos éxitos notables en la aplicación del Banco de su Política de Areas Silvestres, presenta algunos de los problemas que han surgido durante la implementación de proyectos, y expone medidas que pueden ser adoptadas para asegurar éxitos futuros. La Política de Areas Silvestres complementa a varias de las otras iniciativas ambientales del Banco, incluyendo: (a) nuestra directriz operativa sobre procedimientos de evaluación ambiental y (b) el Fondo Ambiental Mundial (Global Environmental Facility, GEF), que financiara actividades de conservación de la biodiversidad que son en adición a aquellas requeridas como mitigación ambiental por la Política de Areas Silvestres.

Note: The personal opinions expressed in this paper are those of the authors and do not necessarily represent the official views of the World Bank or any other organization.

1. The Significance of Wildlands

Wildlands are natural ecosystems which are relatively unmodified by human activities. For operational purposes, wildlands can be defined as land and water areas which retain the great majority (e.g., 90 percent or more) of their native plant and animal species. Wildlands therefore include virgin ecosystems (such as unlogged primary forests), as well as lightly-modified ecosystems where human activities remain compatible with the survival of most (if not all) native species and the continuation of basic ecosystem functions. Following this definition, mature secondary forests, lightly-grazed natural grasslands, coral reefs under traditional fishing regimes, and other lightly-modified ecosystems are regarded as wildlands. When maintained in their natural state, wildlands can contribute significantly to economic development in two principal ways: The conservation of biological diversity (biodiversity) and the maintenance of environmental services.

1.1 Conserving Biodiversity

Preserving as much as possible of the Earth's stock of plant and animal species is important to development because of the economic potential of species that are currently undiscovered, undervalued, or underutilized. In addition, there are important scientific, aesthetic, and ethical reasons to avoid or minimize human-caused species extinctions, which are irreversible. The loss of wildland habitats is currently by far the greatest cause of biodiversity loss worldwide. Appropriate, low-cost wildland management measures can greatly reduce species extinction rates to much lower (perhaps almost "natural" levels), without necessarily slowing the pace of economic progress. While some species can be conserved *ex situ* (such as in zoos or seed banks), wildland management is the only technically and economically feasible means of ensuring the survival of most of the world's existing biodiversity (Ledec and Goodland, 1988).

1.2 Maintaining Environmental Services

In addition to conserving biodiversity, many wildlands (such as forests in upper watersheds and coastal wetlands) also perform important "environmental services" that contribute to sustainable development. These services include: improving water availability and quality for human consumption, industry, and irrigated agriculture; reducing sedimentation of reservoirs, ports, and irrigation works; minimizing floods, landslides, and coastal erosion (and, in some regions, droughts); providing essential habitat for many fish and other species which are important for commercial or subsistence harvesting; and maintaining populations of the pollinators and seed dispersers for many economically important plant species. Despite their economic value and importance in meeting human need, these environmental services have typically not been accorded adequate attention because they are "public goods" that tend to be poorly understood, undervalued, or overlooked. Although many environmental services are provided essentially free of charge by wildlands, they are easily lost through land clearing, inundation, or drainage as wildlands are converted to other uses. Even where replacing these services is possible, it is usually far more expensive than prior maintenance of the wildland area (Ledec and Goodland, 1988).

2. The World Bank's Wildlands Policy

2.1 Policy Guidelines

The Wildlands Policy (World Bank, 1986) codifies a series of guidelines for conserving natural ecosystems within development projects supported by the World Bank Group, which includes the International Bank for Reconstruction and Development (IBRD), International Development Association (IDA), and International Finance Corporation (IFC). The Wildlands Policy specifies the following four requirements for all relevant types of development projects.

- a. The Bank normally declines to support projects which involve, directly or indirectly, the elimination of "wildlands of special concern". These are defined to include existing and officially proposed protected areas, highly threatened ecosystems, known sites of rare or endangered species, and important wildlife areas.
- b. The Bank generally prefers to site development projects on already converted lands, rather than wildlands. Where the conversion of certain limited wildland areas is explicitly justified as a high priority, the Bank seeks to ensure that only those wildland areas with relatively low environmental values are converted.
- c. In those cases where significant wildlands conversion (more than about 100 km², or a significant proportion of the remaining wildland area, if smaller) is justified, this loss is to be compensated through a Bank-supported project component that directly promotes the conservation of an ecologically similar area in one or more protected areas. The aggregate area of compensatory protected areas should be no smaller than the wildland area converted by the project.
- d. For those projects which depend upon the environmental services (such as water supply, sedimentation control, or fisheries habitat) provided by specific wildland ecosystems, the conservation of these wildlands should be explicitly included as a Bank-supported project component).

2.2 Relationship to the Global Environmental Facility

The World Bank's efforts to conserve biological diversity have been recently augmented through Global Environment Facility (GEF). The GEF is a pilot program of grant financing to developing countries for projects with largely global (rather than mainly national) environmental benefits, of four types: biodiversity conservation, reduction of greenhouse gases, protection of international waters, and protection of the stratospheric ozone layer. Although most GEF investment projects for conserving biodiversity involve wildland management, a clear distinction is made between GEF-supported wildlands components and those in the Bank's regular lending program. When the conservation of wildlands is required by the Wildlands Policy as partial compensation for project-induced wildland loss, the cost of such components is financed through regular project funds (i.e., the Bank loan, government counterpart funds, and/or other international co-financing), but not by the GEF. The GEF is intended to be strictly additional to projects supported under the Bank's regular lending program. Mitigatory

wildlands components for regular Bank projects, which are required under the Bank's Wildlands Policy, are therefore ineligible for GEF financing.

3. Implementation of the Wildlands Policy

Since its adoption in June 1986, the Wildlands Policy has served to guide the design and implementation of a sizable number of projects in sectors that include agriculture, forestry, roads, hydroelectric power, water supply, oil and gas, and mining. This paper reviews some of the achievements and lessons learned from application of the Wildlands Policy to development projects specifically in the Latin America and Caribbean (LAC) Region (although the policy applies equally to all regions served by the World Bank). The information presented here is largely derived from a recent internal review of 25 loans with wildland management implications in the LAC Region which were approved by the Bank between 1987 and 1991.

3.1 Types of Bank-Supported Wildlands Components and Projects.

Most Bank-supported wildland management activities in the LAC Region since 1986 have been components of larger projects, principally involving forestry, agriculture (including irrigation), hydroelectric power, water supply, and flood control. In some cases, the wildlands component is intended as compensation for a limited and unavoidable amount of wildland conversion (such as the 400 ha inundated by the Pehuenche Hydroelectric Project in Chile). In other cases, the wildlands component seeks to protect environmental services (such as the watershed protection functions provided by a natural forest in the St. Lucia Water Supply Project).

The Bank is also promoting wildland management through a number of "free-standing" environmental projects, which typically involve providing various types of technical assistance (and related equipment or infrastructure) to national or sub-national environmental agencies. One such project, the US\$149 million Brazil National Environmental Project, was approved in 1990 and is already under implementation. This ambitious project supports a large and varied number of activities to improve wildland management throughout Brazil. Other free-standing environmental technical assistance projects with significant wildlands components are under preparation in several other LAC countries, including Mexico, Venezuela, Bolivia, and Ecuador. (Some of these wildlands components may be partially financed through the GEF, but this is consistent with the Wildlands Policy because mitigation for wildland conversion is not an issue in these projects.)

3.1.1 Improving the Management of Existing Protected Areas.

Probably the most common type of Bank-supported wildlands component in LAC countries is to help strengthen the on-the-ground management of existing protected areas.

Such components may include support for physical demarcation, control posts and other park infrastructure, field and office equipment, development of management plans, and environmental education or other assistance to local communities. Relatively small wildland management components within relevant types of Bank-supported develop-

ment projects can help to transform a "paper park" into a real one that receives adequate on - the -ground management. The Ecuador Lower Guayas Flood Control Project (approved 1990) provides a typical example of this type of wildlands component. This US\$71 million project provides US\$350,000 (supplemented by an additional \$60,000 from non-governmental organizations) for vehicles and other equipment needed to improve the on -the -ground management of the 35,042 ha Manglares Churute Ecological Reserve. The reserve encompasses a sizable mangrove area and protects the habitat of many wildlife species, as well as commercially valuable fish and shrimp populations (some of which are harvested offshore).

3.1.2 Establishing New Protected Areas

Some Bank-supported wildland components involve the establishment of new protected areas. A case in point is the St. Lucia Water Supply Project (approves 1990), which involves the inundation of about 25 ha for this reservoir, the project supports the creation of a 1,500 ha Protection Forest, where agriculture or other non-forest land uses are prohibited. All of the people needing to be resettled under this project (about 160) are being relocated downriver of the dam, in accordance with the Bank's Involuntary Resettlement Policy (World Bank, 1990). Aside from improving the quantity and quality of urban water supplies, the new Protection Forest may (as a result of protection) increase the area of available habitat for the endangered St. Lucia Parrot (*Amazona versicolor*).

3.1.3 Enlarging Existing Protected Areas

At times, the optimal approach for conserving wildlands is to enlarge one or more existing protected areas (rather than to establish new ones). As an example, the wildlands component of the Brazil Land Management I Project (approved 1989) includes (among other features) support for the expansion of four existing protected areas (Lauraceas, Vila Velha, Monge and Jacarezinho) in the state of Parana by a total of about 13,500 ha. Aside from its wildlands component, this project is intended to reduce soil erosion and promote more sustainable management practises on agricultural land outside of the protected areas.

3.1.4 Intensive Management of Threatened Species

While the conservation of representative ecosystems through protected area management is usually the most effective mechanism for preserving biodiversity, intensive management of specific threatened animal or plant species is sometimes necessary. For example, although the Chile Pehuenche Hydroelectric Project (approved 1987) inundates only about 400 ha, the flooded area includes 2 of the last 12 breeding **sites** for the Burrowing Parrot (*Cyanoliseus patagonus bryoni*). As a result, this project includes a captive breeding component for the Burrowing Parrots nesting on cliffs that would be inundated by the reservoir. After capture and captive breeding, the birds are to be released in the vicinity of suitable new nesting habitat (currently unutilized by the species), which is to be protected as part of a National Park. It is also worth noting that the Pehuenche project, while inundating a relatively very small wildland area, will generate a relatively large amount of electric power (500 megawatts).

This is consistent with the spirit of the Wildlands Policy, which seeks to ensure that any limited amount of wildland conversion that occurs under World Bank-supported projects is justified by large economic benefits.

3.1.5 Institutional Strengthening of Relevant Agencies

Institutional strengthening of protected areas agencies is implicit in promoting the improved management of specific protected areas (discussed above). Various Bank-supported projects also have wildland components which promote institutional strengthening of relevant agencies in other ways. For example, the Brazil National Environment Project includes a component to improve natural resource management in the Pantanal (a very large, mostly privately-owned, freshwater wetland) through a variety of institutional strengthening measures. These include improving the government's capability for water pollution monitoring and regulation, establishing an environmental data bank, and increasing the capacity of the Forest Police to control illegal hunting and mining. This project also promotes a substantial amount of training for the staff of environmental agencies (with responsibilities that include wildland management) at the national, state, and local levels.

3.1.6 Reducing Pressures for Wildland Conversion

Conserving wildlands frequently requires more than just the management of strictly protected areas. Important complementary measures are often needed to reduce short-term human pressures for further wildland conversion. Two important approaches in this regard are (a) promoting sustainable resource utilization within multiple-use wildland areas (which may surround more strictly protected areas) and (b) promoting more intensified use of already deforested or degraded lands, as an alternative to further wildland conversion. The Bolivia Agro-Export Development Project (approved 1992) is one example of a project that employs both strategies. It will finance the collection and processing of wild Brazil Nuts (*Bertholletia excelsa*), which can be a sustainable, profitable, and environmentally benign form of tropical forest utilization in portions of Amazonian Bolivia. The project also promotes the production by peasant farmers of angora wool, cut flowers, cochineal, and other labor-intensive export crops in the Bolivian highlands. By providing a adequate income to rural people in the highlands, this project should help to reduce the rate of migration into the environmentally sensitive, forested lowlands of northern and eastern Bolivia.

3.1.7 Adjustment Loans

Although most World Bank loans with wildland components involve specific *investment* projects, there are occasionally opportunities to incorporate wildland management concerns within *adjustment* loans. Adjustment loans are provided by the Bank to member governments to support various institutional and policy reforms, rather than any specific investment projects. A case in point is the US\$300 million Colombia Power Sector Adjustment Loan (approved 1987). Among the policy reforms supported by this loan was the formulation of a Least-Cost Power Expansion Plan, which the government has agreed to follow in selecting future hydroelectric projects. In the Colombian electric power sector, "least-cost" has been defined to include environmental costs (including

wildland inundation), in addition to standard economic costs. Since less than 10 percent of Colombia's potential hydroelectric power capacity has been developed, there remain many different options for future hydroelectric project sites, some of which would flood much more land than others (per unit of electricity produced). Under the adjustment loan, an innovative methodology has been used to rank potential new hydroelectric project sites throughout Colombia, in terms of wildland inundation and other environmental variables. As a result, the more environmentally benign projects (with fewer negative implications for wildlands) have been advanced within the Expansion Plan, while the more problematic projects (especially those involving very large reservoirs) have been deferred and will not be developed within the foreseeable future.

3.2 Lessons Learned

The Bank's efforts to implement the Wildlands Policy successfully have yielded a large number of valuable lessons. Several of these are discussed below.

3.2.1 Wildland Component Preparation

To be successful, wildland components need to be carefully planned, usually during the early stages of project preparation. The Bank's experience to date indicates that the most successful wildland components tend to have all of the following five characteristics.

First, the specific investments and activities to be supported under the wildland components should be spelled out in detail. Second, there should be an implementation timetable (chronogram) for each planned activity. Third, there should be a relatively detailed budget of planned expenditure. Fourth, the expected sources of financing for each budget item should be specified, for investments (e.g., demarcation, infrastructure, equipment, management plan preparation, training, and studies), as well as recurrent costs (e.g., staff salaries, fuel, and spare parts). Fifth, if more than one agency is involved in implementing the wildland component, there should be a precise division of institutional responsibilities between each agency.

3.2.2 Inter-Agency Coordination

Development projects for which the wildland component is intended as environmental mitigation tend to have a principal executing agency which is different from the wildland management agency. For example, the transportation ministry may be responsible for the construction of project-financed highways or rural roads, while the environment ministry (or equivalent) may be responsible for implementing any environmental mitigation components (including wildland management). There is therefore a need for such projects to ensure adequate inter-agency coordination. In particular, projects that generate a significant amount of additional work for wildlands or other environmental agencies (which are usually already overextended) need to provide these agencies with a commensurate increase in staff and/or budgetary resources.

3.2.3 Accommodating the Needs and Interests of Local People

The success of protected areas depends largely upon the cooperation of people who live

near or, in some cases, within the reserves. It is therefore important to involve local people in the process of protected area management planning. Local support is also enhanced to the extent that protected area management objectives (e.g., to conserve biodiversity and various environmental services) can be achieved in ways that also provide benefits to local communities (or, at a minimum, do not significantly disadvantage them). In the case of indigenous people living in or near protected areas, the Bank's Indigenous Peoples Policy (World Bank, 1991a) provides guidelines for designing and implementing wildland management (and all other types of projects) in ways that are beneficial to these groups.

3.3 Bank Initiatives to Improve Future Wildlands Policy Implementation

Two recent World Bank initiatives which should further improve implementation of the Wildlands Policy deserve special mention. One is the Bank's recently revised Operational Directive on Environmental Assessment (World Bank, 1991b), which outlines environmental impacts (including all projects which may affect wildlands). The detailed procedural requirements of this Directive help to ensure that wildland management (like all environmental issues) receives sufficient attention in the early stages of project preparation, when the opportunities for influencing project design are greatest. The Directive also requires that environmental mitigation plans be prepared as part of the environmental impact studies required for all projects with significant effects upon wildlands (or other major environmental concerns). These mitigation plans should include (where relevant) the detailed design features of proposed wildland components, prior to Bank appraisal of the proposed project.

The other significant initiative is that the Wildlands Policy is presently being rewritten within the Bank in the form of an Operational Directive. Aside from highlighting further the need for Bank staff to address wildlands adequately during project design, the new Wildlands Policy Directive is expected to include a number of revisions and clarifications, based on the Bank's experience with wildland management to date. These improvements in the Wildlands Policy should further improve the Bank's ability to address wildlands issues in future projects throughout the developing world.

4. Conclusion

Wildland management issues are becoming increasingly better integrated within the preparation and implementation of Bank-supported projects. Although success in implementing wildland components has varied, the Wildlands Policy has proven itself as a workable approach to incorporating conservation concerns within relevant types of Bank-supported projects. With few exceptions, efforts by the Bank to include wildland components within relevant types of development projects have received a high degree of acceptance from borrower governments in the LAC Region. Moreover, as both the Bank and our member governments gain additional experience in designing and administering wildland components, implementation is expected to improve further.

The Wildlands Policy reflects the perception that while a limited amount of additional wildland conversion may be needed to achieve economic development objectives, many wildland areas make their greatest contribution to economic development and human

well-being by remaining in their natural state. Although wildland management issues are inherently complex and implementation has been somewhat uneven, there is no doubt that the Wildlands Policy has improved the World Bank's work from an environmental standpoint. The Wildlands Policy may therefore provide a useful model for the formulation of internal environmental policies by other international development agencies. Certain governments may also wish to use elements of the wildlands policy as inputs to developing national legislation or regulations governing wildland use.

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WILDLANDS:
THEIR PROTECTION AND MANAGEMENT
IN ECONOMIC DEVELOPMENT

Operational Policy
THE WORLD BANK

THE WORLD BANK'S OPERATIONAL POLICY ON:
WILDLANDS: THEIR PROTECTION AND MANAGEMENT
IN ECONOMIC DEVELOPMENT

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Note: This document is essentially verbatim internal policy effective June 1986, and distributed to all operational staff of the World Bank on June or July 1986. The few deletions refer to internal communications and memoranda.

1. INTRODUCTION

1. The maintenance of specific natural land and water areas in a state virtually unmodified by human activity, hereafter termed wildland management, is an important subset of the broad environmental concerns addressed in "Environmental Aspects of Bank Work", 1984. The conversion of wildlands to more intensive land and water uses (through land clearing, inundation, plantations, or other means)^{1/} continues to meet important development objectives, and is an element of certain World Bank-supported projects. At the same time, wildlands are rapidly diminishing in many Bank member countries. The remaining wildlands can often contribute significantly to economic development, particularly in the longer term, when maintained in their natural state. The Bank's policy therefore is to seek a balance between preserving the environmental values of the world's more important remaining wildlands, and converting some of them to more intensive, shorter term human uses.

2. The World Bank already has considerable experience of wildland management in Bank-supported projects. This policy codifies existing practices and provides operational guidance concerning conservation of wildlands.^{2/} For a more detailed discussion of wildland management, see the Bank's Technical Paper: Wildlands: Their Protection and Management in Economic Development^{3/} which amplifies each section of this policy. The Office of Environmental and Scientific Affairs in the Projects Policy Department (PPDES) can be contacted for further information.

2. JUSTIFICATION

3. There are two principal justifications for wildland management. First, wildlands serve to maintain biological diversity (i.e., the full range of the world's biota). Second, wildlands provide environmental services important to society. In addition, certain wildlands are essential for maintaining the livelihood of tribal peoples, discussed in OMS 2.34.

2.1 Biological Diversity

4. Wildland management is necessary to prevent the untimely and often irreversible loss of a large proportion of the world's remaining

^{1/} Conversion here applies to permanent fundamental alteration of the natural ecosystem. Temporary modification by such means as highly selective, long rotation logging usually creates fewer relevant effects.

^{2/} Other conservation activities (designed to protect the environment, but not necessarily to preserve biological diversity) are discussed elsewhere, e.g., in the 1978 Forestry Sector Policy Paper.

^{3/} Available from the Office of Environmental and Scientific Affairs.

biota, including the more visible plant and animal species. Because their wildland habitats are today rapidly disappearing, a large and growing number of plants and animals face extinction. Appropriate, low-cost wildland management measures can greatly reduce current extinction rates to much lower (perhaps almost "natural") levels, without slowing the pace of economic progress. By preserving the integrity of the biotic community and its plant and animal species, wildlands are important for the replenishment of surrounding degraded or abandoned areas.

5. Preserving biological diversity is important to development because of the economic potential of species that are currently undiscovered, undervalued, or underutilized. Many previously unknown or obscure, and often threatened, species have turned out to have major economic benefits. But less than 20 percent of the world's plant and animal (largely invertebrate) species have ever been inventoried, and even fewer screened for possible human uses. They therefore present valuable development opportunities if they are not irreversibly destroyed. In addition, there are important scientific, aesthetic, ethical, and practical reasons to avoid or minimize the extinction of the remaining biotic stock. While some species can be conserved ex situ (such as in zoos or seed banks), wildland management is the only technically and economically feasible means of preserving most of the world's existing biological diversity.

2.2 Environmental Services

6. In addition to maintaining biological diversity, many wildlands also perform important "environmental services", such as improving water availability for irrigated agriculture, industry, or human consumption; reducing sedimentation of reservoirs, harbors, and irrigation works; minimizing floods, landslides, and coastal erosion (and possibly droughts in some regions); improving water quality; and providing essential habitat for economically important fishery species. Despite their economic value and importance in meeting human needs, such environmental services are not always accorded adequate attention because they are usually public goods that tend to be poorly understood, undervalued, or even overlooked. When environmental services are lost due to wildland elimination, remedial measures are almost always far more expensive than prior maintenance. While many environmental services can also be maintained by establishing more intensive water and/or land use systems (e.g., bio-oxidation sewage treatment, tree plantations), wildland management is frequently more cost-effective.

2.3 Wildlands of Special Concern

7. Wildlands of special concern are areas that are recognized to be exceptionally important in conserving biological diversity or perpetuating environmental services. They can be classified into two types. First are wildlands officially designated as protected areas by governments, sometimes in collaboration with the United Nations or the international scientific community. These are National Parks, Biosphere Reserves, World Heritage Natural Sites, Wetlands of International Importance, areas

designated for protected status in national conservation strategies or master plans, and similar "wildland management areas" (WMAs), i.e., areas where wildlands are protected and managed to retain a relatively unmodified state (Annex 1).

8. Second are wildlands as yet unprotected by legislation, but recognized by the national and/or international scientific and conservation communities, often in collaboration with the United Nations, as exceptionally endangered ecosystems, known sites of rare or endangered species, or important wildlife breeding, feeding, or staging areas. These include certain types of wildlands that are threatened throughout much of the world, yet are biologically unique, ecologically fragile, or of special importance for local people and environmental services. Wildlands of special concern often occur in tropical forests, Mediterranean-type brushlands, mangrove swamps, coastal marshes, estuaries, sea grass beds, coral reefs, small oceanic islands, and certain tropical freshwater lakes and riverine areas. Within the spectrum of tropical forests, lowland moist or wet forests are the most species-rich and often the most vulnerable. Wildlands of special concern also occur in certain geographical regions (Annex 2) that have been reduced to comparatively small patches and continue to undergo rapid attrition. As a result, these regions harbor some of the most threatened species in the world.

3. THE BANK'S INVOLVEMENT TO DATE

3.1 Existing Record

9. During the last 15 years, the World Bank Group^{4/} has assisted with financing of upwards of 40 projects with significant wildland management components. Most of them have involved establishment or strengthening of WMAs. Bank-supported WMAs include national parks, nature reserves, wildlife sanctuaries, and those forest reserves managed primarily for their watershed or biological values, rather than for wood harvest. Other wildland management components of Bank projects have involved management of wildlife and the humans that utilize it, including anti-poaching measures, management of water flows from reservoirs to maintain wildlife habitat, and relocation of certain species. In still other cases, the location of projects has been changed to avoid important wildland areas.

10. Wildland management components have two principal objectives: first, to prevent, minimize, or partially compensate for wildland elimination, thereby conserving biological diversity; second, to preserve or improve the environmental services provided by wildlands, thereby enhancing the project's economic or social benefits. Most Bank-supported

^{4/} Includes the International Development Association (IDA) and the International Finance Corporation (IFC).

projects emphasize one or the other objective, however some Bank-assisted projects have wildland components seeking both objectives. ^{5/}

11. Costs of wildland management components in Bank-assisted projects have typically been low. They have normally accounted for less than three percent of total project costs, and in half of the cases for less than one percent. In many instances, it is difficult to separate out the cost of the wildland component because of its integration with other components.

12. In one case, wildland management was the sole objective, so accounts for 100 percent of project costs. At the other extreme, a large number of Bank projects have achieved significant wildland management objectives at zero additional cost. For example, manipulation of a hydroelectric project's water release schedule costs little or nothing, even though it provides major downstream benefits for wildlife, as well as for people and cattle.

13. Wildland management components require additional Bank staff time and can increase project complexity, but they have rarely caused significant delays at any stage of the project cycle. Moreover, the failure to incorporate adequate wildland components can result in much greater delays and complexity later on. Furthermore, the failure to incorporate adequate wildland components can substantially reduce project benefits and might result in project failure. As wildland management components within Bank-supported projects become more routine, the additional staff effort required to manage them successfully is expected to decrease further.

14. The Bank's track record in implementing wildland management components is encouraging. According to project completion reports or environmental post-audits, implementation of only three out of 43 wildland components has been markedly slower than for most other project components. In at least four cases, the wildland component has been implemented with less difficulty than other project components.

3.2 Lessons Learned

15. A number of important lessons have emerged from the Bank's experience with wildland management to date. First, wildland management components should be routinely and systematically incorporated into certain types of Bank projects (outlined in Section 4.1). Up to now, this has not always been done, and some projects which would have benefitted from wildland components have not included them.

^{5/} For example, the establishment of the Dumoga-Bone National Park in the Indonesia Irrigation XV project helps ensure a more reliable water supply while reducing sedimentation of valuable irrigation works; at the same time, it helps ensure that a significant portion of the project area remains in its natural state, despite surrounding developments.

16. Second, wildland components should be incorporated as early as possible within the project cycle (Annex 3) to minimize costs and facilitate implementation. While inclusion of wildland components in later stages of the project cycle may at times be necessary because of unforeseen circumstances, it is more effective and less costly to incorporate them as early as possible in the project cycle.

17. Third, meeting wildland management goals requires effective management "on the ground," not simply on paper. Colonists and resource extractive companies have rapidly moved into such "paper parks" (parks existing only on a legal document or map, rather than on the ground) unless they were inaccessible for other reasons. The wildland management objectives have to be translated into specific measures with a budget for their implementation. These measures include hiring and training of personnel, provision of necessary infrastructure and equipment, development of a scientifically sound management plan for each particular wildland, and a policy environment - legal, economic and institutional - which supports the wildland preservation objective. The mere declaration of intent to protect wildlands or wildlife, or even the designation of WMAs on a map, does not ensure effective management unless specific supporting measures are implemented.

18. Fourth, the multiple objectives of wildland management are most successfully attained if the WMA is carefully designed. For example, a WMA cannot preserve biological and genetic diversity, evolutionary processes, and environmental services if it is too small. While some Bank-supported WMAs clearly appear sufficiently large to accomplish most or all of their objectives, others are so small that their ability to conserve biological diversity or provide environmental services or other benefits is questionable. Besides size, the specific location and shape of a WMA can be important factors in determining its success. Appropriate WMA design features are best determined for each case by a conservation specialist.

19. Finally, the success of a WMA, as of other project components, is contingent upon government commitment. This, in turn, often depends upon the degree of financial support provided by the Bank. Most of the Bank-supported wildland components have provided some direct support to establishing or strengthening WMAs. However, in some cases, the costs of the WMA establishment were assumed entirely by the Government, and the Bank took no specific measures to ensure the continued availability of such financing. By taking measures to ensure counterpart financing, or by providing the financing itself, the Bank can help ensure the availability of the relatively modest sums necessary for WMA establishment and continuation.

20. Financial support is usually not sufficient, however. It is often also necessary to maintain dialogue with governments, affected local people, and environmental advocates about the importance of conservation and the benefits of WMAs (tourism, watershed protection, etc.) and to include local people in the planning and benefits. Government commitment to the WMA is fostered by such dialogue, by supervision, by monitoring of national legal provisions, and by loan conditionality. In addition, two

complementary and parallel activities contribute to WMA success: (1) rural development investments that provide farmers and villagers in the vicinity of the WMA an alternative to further encroachment, and (2) coherent national and sectoral planning and policies that promote wildland conservation.

4. POLICY GUIDANCE

21. The World Bank's general policy regarding wildlands is to seek to avoid their elimination and rather to assist in their preservation. Specifically, (1) the Bank normally declines to finance projects involving conversion of wildlands of special concern (as defined in Section 2.3), even if this conversion occurred prior to the Bank being invited to consider financing. (2) When wildlands other than those of special concern may become involved, the Bank prefers to site projects on lands already converted (e.g., logged over, abandoned, degraded, or already cultivated areas) sometime in the past, rather than in anticipation of a Bank project. Deviations from this policy must be explicitly justified. (3) Where development of wildlands is justified, then less valuable wildlands should be converted rather than more valuable ones. (4) When significant conversion (e.g., 100 sq. kms., or a significant proportion of the remaining wildland area of a specific ecosystem, if smaller) of wildlands is justified, the loss should be compensated by inclusion of wildland management components (see Section 4.2 below) in the project concerned, rather than in some future project. This component should directly support preservation of an ecologically similar area.^{6/} This policy pertains to any project in which the Bank is involved, irrespective of whether the Bank is financing the project component that affects wildlands.

22. The success of projects that do not eliminate any wildland often depends on the environmental services provided by wildlands. In such cases, the Bank's policy is to include a project component to conserve the relevant wildland in a WMA, rather than leaving its preservation to chance. In areas without remaining wildlands, alternative conservation measures may be needed to provide similar project benefits. In other cases, where the wildlands do not directly benefit or serve the objectives of the project, the project may be improved by supporting management of wildlands to provide socio-economic benefits in the general project area (see paragraph 6). Projects with wildland management as the sole objective should also be encouraged.

4.1 Types of Projects Needing Wildland Management Components

23. Based upon these criteria, projects with the following aspects should normally contain wildland components:

^{6/} The policy in the 1978 Forestry Sector Policy Paper states ".... in countries where there are no adequate natural resource conservation programs, the Bank will not support projects that might result in disintegration of a habitat not elsewhere represented in the country and not under suitable protection (as in national parks and wildlife reserves)."

- a. Agriculture and livestock projects involving: wildland clearing, wetland elimination ^{7/}, wildland inundation for irrigation storage reservoirs; watershed protection for irrigation; displacement of wildlife by fences or domestic livestock; fishery projects involving: elimination of important fish nursery, breeding, or feeding sites; overfishing or introduction of ecologically risky exotic species within aquatic wildlands; forestry projects involving: access roads, clear-felling or other intensive logging of wildlands, wildland elimination.^{8/}
- b. Transportation projects involving: construction of highways, rural roads, railways, or canals which penetrate wildlands, thus easing access and facilitating spontaneous settlement; channelization of rivers for fluvial navigation; dredging and filling of coastal wetlands for ports projects.
- c. Hydro projects involving: large-scale water development, including reservoir, power, and water diversion schemes; inundation or other major transformation of aquatic or terrestrial wildlands; watershed protection for enhanced power output; construction of power transmission corridors.^{9/}
- d. Industry projects involving: chemical and thermal pollution which may damage wildlands ^{10/}; wildland loss from large-scale mining; wildland conversion for industrial fuels or feedstocks.

4.2 Types of Wildland Management Components

24. The most effective type of wildland management component is support for the conservation of ecologically similar wildlands in one or

^{7/} Wetlands (such as ponds, marshes, swamps, flood plain forests, estuaries, mangroves) can be eliminated inadvertently through water diversions upstream or deliberately through drainage, diking, or filling.

^{8/} Plantations of fast-growing tree species are often an important complement to more direct wildland management activities by reducing the economic pressures for cutting the remaining forest wildland. They should be sited preferentially on already deforested land. Reforestation and land rehabilitation are covered in the 1978 Forestry Sector Policy Paper.

^{9/} & ^{10/} Industrial pollution control is discussed in the Bank's Environmental Guidelines available from PPDES.

more WMAs. ^{11/} In cases where a WMA already exists in the same type of ecosystem that is to be converted by a Bank-supported project, it may be preferable, for administrative or biological conservation^{12/} reasons, to enlarge the existing WMA, rather than to establish a new one. The government's wildland agencies, local university wildlife departments, and various international organizations can often advise in such judgements.

25. A wildland management component could also involve the creation of wildlife habitat, in addition to or rather than preservation of already existing habitat. For example, marginal land on the fringes of irrigation projects could be converted to wildlife reserves by taking advantage of the water supply created by the projects. Natural depressions or seasonal swamps could be exploited by diverting water from the canal systems (probably a very small part of the total supply). Such reserves attract significant numbers of migratory and residential waterfowl with minimal additional project costs and land.^{13/}

26. A useful option is to improve the quality of management of existing WMAs. Many WMAs in Bank member countries receive insufficient on-the-ground management, due to lack of adequately paid staff, training, staff housing, other infrastructure, equipment, spare parts, fuel, or a well-developed management plan through which efficient resource allocation decisions can be made. Small components can often help correct these deficiencies. In countries where effective management is clearly lacking, it is generally preferable to improve the management of existing WMAs than to create new units "on paper", thereby further overextending the limited capabilities of the responsible agencies. Whenever a new WMA is established as a project component, provisions are needed to ensure effective management. Since many wildland agencies (e.g., departments of national parks or wildlife) are not as operationally effective as necessary, institutional strengthening (particularly support for training) should be an important element of Bank-supported wildland management components.

27. The establishment or strengthening of WMAs is particularly effective when the Government includes these wildland areas in a national conservation or land use plan. A growing number of Bank member governments have undertaken some type of systematic land use planning for wildland management. Such planning can take various forms, ranging from "master plans" for a system of national parks and other WMAs, to "National Conservation Strategies" which address wildland management as only one component of a broad range of natural resource planning concerns, and in

^{11/} See Section 5 for technical guidance on establishing a WMA.

^{12/} Biological conservation is usually more effective in one large WMA than in several small ones comprising the same total size and encompassing the same types of natural habitats.

^{13/} The Wildfowl Trust, Slimbridge, England, has set up such reserves on 5-8 sq. km.

which policy intervention such as economic incentives are used to influence resource utilization. Bank assistance with such planning efforts greatly strengthens wildland management at the national level. When member governments agree to develop appropriate land use plans, it is important for the Bank to refrain from supporting projects which involve eliminating wildlands and run counter to these plans.

28. In those relatively few Borrower countries in which wildland elimination pressures are still minor, ^{14/} the requirement of a compensatory wildland component can be interpreted more flexibly to involve measures other than the establishment or strengthening of one or more WMAs. Such alternative options include careful project siting to avoid converting the more environmentally sensitive wildlands, support for research on and management of particularly sensitive species, support for land use planning efforts, or institutional strengthening of the government's wildland management agency, and training in ecology, biological conservation, and wildland management.

5. DESIGN OF WILDLAND MANAGEMENT AREAS

5.1 Design Considerations

29. WMA design features include size, shape, and siting. Because an optimal design may vary greatly in different ecosystems, it is best determined in each case by a conservation specialist.

30. The size of a compensatory WMA should be sufficient to maintain the biological diversity or other important values present in the area to be converted. A WMA which is large enough to encompass a viable population of the largest local predator (e.g., eagle, tiger), or the seasonal territories and migration routes of the largest local herbivore, will most likely preserve all other pertinent ecological values. These objectives would most likely be achieved in a WMA larger than 1,000 sq. kms. Many values are conserved in moist forest WMAs of 500 sq. kms. although possibly not all in perpetuity. Interim WMAs of less than 100 sq. kms. can be useful short-term expedients for subsequent expansion into surrounding degraded areas. In general, the larger the WMA, the greater the number of ecological interdependencies and gene pools that will be preserved. Both are necessary to a healthy and self-perpetuating ecosystem. It is recognized that conflicting pressures for more intensive land use often make the establishment of large WMAs difficult. In any case, compensatory WMAs should be no smaller than the wildland area converted by the project.

^{14/} Wildland elimination pressures may still be minor because of low human population densities and growth rates, little economic demand for agricultural land, timber, or other resources, or because a substantial proportion of each remaining wildland ecosystem in a country has been set aside in WMAs which receive good on-the-ground protection and have strong policy support from the Government.

31. The optimal shape of a WMA will depend upon its objectives. A more circular shape may preserve more biological diversity than other shapes of the same area. Shape is also determined by the location of centers of endemism and other wildlife resources. Boundaries are more effective when they coincide with natural surficial features, such as a river or watershed.

32. To ensure that the compensatory WMA is ecologically similar to the area to be converted, it is obviously necessary to site the WMA in the same ecosystem as the area to be converted. Moreover, siting the WMA some distance away from the converted area (separated by a managed buffer zone for example) helps reduce pressures for encroachment upon the WMA from people living in the converted area.

5.2 Management Categories

33. A variety of different use related categories can be used in establishing WMAs. The choice of category depends upon the particular objectives being accorded priority for management. The categories listed in Annex 1 indicate the variety of WMAs appropriate under different circumstances.

5.3 Personnel and Training Needs

34. The need for well-trained personnel in the proper management of WMAs cannot be overemphasized. Without adequate numbers of such trained people, WMAs cannot effectively serve their intended national or societal functions. Bank-supported wildland project components should therefore provide for staffing levels and training activities that ensure competent management of WMAs. The appropriate number and types of WMA personnel depend upon the category of WMA, its size, and its intensity of management. The minimum adequate permanent staff size for a "modest to average" WMA is usually about eight.

5.4 Equipment, Infrastructure, and Budgetary Needs

35. Designation of WMAs on a map in no way ensures that they will be managed to provide their greatest possible benefits to society. Effective on-the-ground management requires a variety of physical inputs. In Bank-supported WMAs, efforts should be made to ensure that these inputs are provided as a project component in adequate supply and on a timely basis. Annex 4 contains a basic checklist of the physical inputs that are typically needed for effective WMA management. Some types of WMAs will require a variety of additional inputs, according to specific management objectives.

36. The budgetary requirements for establishing and operating WMAs will vary according to size and the amounts of needed infrastructure, equipment, and personnel. The comparatively large (3,200 sq. kms.) Dumoga-Bone National Park, financed by the Indonesia Irrigation XV Project, cost roughly US\$1 million for establishment and initial operating costs; most smaller WMAs can be expected to cost considerably less.

37. In some instances, establishment or enlargement of WMAs may require additional funds for purchasing land from private or tribal owners. It may at times also be necessary to resettle and compensate people living within the boundaries of a newly-established WMA.^{15/} Usually, however, WMAs are established on wholly government-owned properties on which people have not settled.

38. The largest recurrent cost of WMAs is usually staff salaries. It is important to maintain salaries at levels that encourage high productivity and a degree of permanence, and discourage corruption.^{16/} Spare parts for machinery, while usually a relatively small budget item, are also a vital recurrent expenditure. Without a reliable supply of spare parts for often remote WMA areas, necessary equipment will often lie idle or may become cannibalized to provide spare parts. In some cases, salaries, spare parts, fuel, and other recurrent costs can be fully or partly met by fees collected from tourists, persons engaged in some form of harvesting, or scientific researchers.^{17/} Otherwise, small annual outlays from the national or other government budget will be needed.

5.5 Management Plans

39. Wildland management areas typically need well-developed management plans to ensure efficient allocation of the scarce financial and skilled human resources devoted to their management. A management plan is a written document which guides and controls the use of the resources of a WMA and directs the design of subsequent programs of management and development. A thorough management plan will:

- (a) Describe the physical, biological, social, and cultural features of the WMA within a national, regional, and local context;
- (b) Identify those items of particular concern from which the objectives for managing specific areas of the WMA are derived;
- (c) Describe appropriate uses of the entire WMA through zoning; and

^{15/} Guidelines regarding involuntary resettlement and tribal people in Bank-financed projects are available on request. In many cases, indigenous hunter-gatherer societies are as much a part of the "natural" environment as the wildlife, and can safely remain in the park as caretakers as long as traditional ways of life are continued.

^{16/} High productivity also depends upon these important components: 1) environmental education for an understanding of the importance of the WMA; 2) pride in the WMA and the role of those who protect and support it; and 3) self-interest through some direct accrual of benefits of the WMA (aesthetic, recreational, moral, etc., as well as economic).

^{17/} The proportion of recurrent costs that can be recovered in this manner varies greatly in different WMAs, from 0 to 100 percent.

- (d) List in chronological order the activities to be carried out to realize the proposed management programs.

40. Preparation and implementation of management plans are carried out by the government wildland agency. Project staff should ensure that Bank-supported WMAs either have adequate management plans or will develop them early in the project. Some parts of a management plan can be completed in a few days, while others may take years to refine. While a longer-term management plan is being developed as soon as possible after loan signing, an "interim management plan" or "operational plan" may be used. PPDES can be of assistance in these matters.

5.6 Legal Considerations

41. The success of a WMA may depend upon how its design fits into an overall national legal framework concerning natural resources management in general and wildland management in particular. To maintain their legitimacy in the eyes of policy-makers and local populations, WMAs must have a firm legal foundation. National legislation, sometimes accompanied by a specific Presidential designation, is often needed to establish a WMA. Depending upon the particular situation, such legislation needs to establish precise WMA boundaries; specific management zones within the WMA, including buffer zones; a central management authority (at the national or sub-national level) with unambiguous responsibilities; and a mechanism to channel local participation in WMA management decisions. Bank staff should ensure that Bank-supported WMAs are established and managed within a compatible legal and policy context.

CATEGORIES OF WILDLAND MANAGEMENT 18/

1. Scientific or Strict Nature Reserves represent the most restrictive WMA category, intended to maintain representative samples of natural ecosystems in an undisturbed state for scientific research, environmental monitoring, education, and preservation of biological diversity. Tourism, recreation, and most other human uses are usually not permitted.
2. National Parks are usually relatively large areas where native plant and animal species (and often outstanding geological or other scenic features) are of special interest. Controlled tourism and scientific research are permitted; more intensive human uses usually are not.
3. Natural Monuments are often smaller WMAs intended to protect highly localized species, ecosystems, or geological formations. Tourism and scientific research are permitted to the extent that they are compatible with preservation of the unique natural features.
4. Managed Nature Reserves or Wildlife Sanctuaries protect rare plant or animal species, or large concentrations of resident or migratory wildlife. Manipulation of vegetation and other intensive management may be done to improve the habitat for species of special concern. Tourism, research, and occasionally limited livestock grazing or fuelwood collection are permitted, when these activities are compatible with wildlife management objectives.
5. Tribal Peoples Reserves are relatively unmodified natural areas in which indigenous tribal peoples or vulnerable ethnic minorities continue to practice traditional, low-intensity forms of land use such as hunting and gathering or nomadic pastoralism. Settlement or potentially disruptive resource utilization by outsiders is not permitted.
6. Protected Landscapes are areas which have often been significantly modified by people, but which still contain important wildland resources. Traditional land uses, including fishing, grazing, and some agriculture, are often permitted to accommodate the needs and interests of local populations. Land use control is often at the local government level.

18/ Recognizing that different countries use different names for various types of WMAs, the standardized system of WMA nomenclature developed by the International Union for Conservation of Nature and Natural Resources (IUCN) is used here to facilitate comparisons and reduce confusion.

7. Resource Reserves are "interim" WMAs. They are typically fairly extensive areas which are not yet heavily settled, but which may be under relatively recent pressure for colonization, timber or mineral extraction, or other intensive uses. This WMA category is designed to restrict such uses until a land use plan or other management guide is issued to channel further development in an environmentally suitable manner.
8. Multiple Use Management Areas are intended to allow sustainable production of such economic goods as water for downstream uses; timber (obtained through low-intensity logging); fuelwood; wild fruits, herbs, gums, or other plant products; wildlife; fish; grazing; and outdoor recreation. Included in this category are most "forest reserves" and "protection forests," including those established largely for watershed catchment protection. Within these WMAs, management is primarily oriented to the sustaining of these economic activities, although special zones may also be designated within these areas to achieve more specific conservation objectives, such as preservation of biological diversity. These WMAs are generally large and capable of sustaining these types of economic activities without degradation or elimination of the wildland resource. Generally, these wildland areas do not possess nationally unique or exceptional natural features.

SOME TROPICAL WILDLANDS OF SPECIAL CONCERN ^{19/}

EASTERN AFRICA

- 1 Madagascar: significant proportions of the northern and eastern moist forests.
- 2 Ethiopia: much of the remaining highland forest.
- 3 Tanzania: Usambara, Pare, and Uluguru Mountains.
- 4 Rwanda: mountain forests along the Zaire and Uganda borders.
- 5 Kenya: Kakamega, Nandi, and Arabuko-Sokoke forests.

WESTERN AFRICA

- 6 Cameroon: particularly Cameroon Mountain and the moist forested area extending into Gabon, and to the vicinity of the Cross River in southeastern Nigeria, including the Oban Hills.
- 7 Ivory Coast: southwestern forests (including the Tai forest), and adjacent parts of Liberia and Sierra Leone.

EAST ASIA AND PACIFIC

- 8 The Malay Peninsula (including parts of Thailand): Lowland forests, especially along the northwestern and eastern coasts.
- 9 Indonesia: much of the remaining lowland forests of Kalimantan, Sumatra, Sulawesi (especially the two southern peninsulas), and many smaller islands (e.g., Siberut).
- 10 Philippines: much lowland forest on all larger islands.

SOUTH ASIA

- 11 Sri Lanka: the coastal hills of the southwest and the Sinharaja forest of the "wet zone."
- 12 India: most of the forests remaining on the Western Ghats
- 13 Burma: the untouched teak forests in the northern regions.

LATIN AMERICA AND CARIBBEAN

- 14 Ecuador: lowland coastal forests.
- 15 Mexico: Lacandon forest in Chiapas.
- 16 Honduras-Nicaragua border: Mosquitia forest.
- 17 Panama: Darien province.
- 18 Colombia: the Choco region adjacent to Darien province.
- 19 Brazil: coastal forests of the "Cocoa Region" in the southeastern extension of Bahia between the coast and 41°30' W longitude, and between 13° and 18°15' S latitude, and an outlier near Linhares, Espiritu Santo.
- 20 Brazil: parts of the eastern and southern Amazon region.

^{19/} This list is by no means to be interpreted as comprehensive.

TROPICAL AQUATIC AREAS

1. Amazon River and associated wetlands (including varzea forests)
(Brazil, Peru, Colombia, Ecuador, and Bolivia.)
2. Orinoco River and Delta (Venezuela and Colombia).
3. Purari River (Papua New Guinea).
4. Musi River (Sumatra, Indonesia).
5. Lake Malawi (Malawi), and other Rift Valley Lakes.
6. Lake Toba (Sumatra, Indonesia).
7. Sudd Swamp (Sudan).
8. Pantanal Swamp (Mato Grosso, Brazil).
9. Lake Atitlan (Guatemala).

THE PROJECT CYCLE

Responsibility for implementing wildland management projects or components rests primarily with regional operations staff, with advice and operational support provided by PPDES. At identification, projects being considered are reviewed by regional staff in conjunction with PPDES to identify, as early as possible, the need to avoid converting a wildland tract or to preserve such a tract as part of the project. To determine whether a proposed project will develop or be in close proximity to environmentally important wildlands, Bank staff can consult those government agencies with jurisdiction over wildland management authority. PPDES maintains contacts with such agencies and will assist upon request. Additional sources of information on ecologically important wildlands are computerized data bases maintained by some non-governmental organizations (NGOs) and several published directories, available from PPDES. In this manner, it will often be possible to learn quickly whether a proposed project site contains existing or proposed WMAs; known endangered species; major wildlife or fish breeding, feeding, or staging areas; important watershed catchments; or living resources of major importance to local people. If none of these mechanisms reveal the existence of ecologically important wildlands in the project area, a brief pre-project field survey is necessary since many important wildlands are not yet identified. This field survey should be undertaken by relevant specialists from the government's environmental ministry, wildlife agency, national university, or similar institution. This brief survey indicates the nature and extent of impacts on critical wildlands that would result from the implementation of the project and puts the information in a national context. The results should be recorded on the form provided in Annex 5.

During preparation, project staff (or their consultants) may assist the Borrower or project sponsor in carrying out the necessary environmental studies, including those pertaining to wildlands. PPDES can recommend consultants or other experts who can identify important wildland areas, carry out necessary field surveys, or help design appropriate wildland management project components. At the completion of any necessary studies, the Project Brief should highlight whether the project involves the conversion or disintegration of a relatively unmodified ecosystem and include alternative suggestions for achieving the goals of the government. If conversion is justified, the Brief should outline why, together with the wildland management components needed.

As part of appraisal, project staff assess the planned wildland management and other environmental measures. The Staff Appraisal Report specifically describes any planned wildland management measures, including budgets and agency responsibilities. Once wildland measures are identified as necessary, timely action should be ensured by conditionality such as loan effectiveness or disbursement. Since wildland management must be done in perpetuity to be effective, the loan agreement should specify long-term measures which the Borrower has agreed to implement.

Supervision missions should routinely review implementation of the wildland component with the Borrower. Such aspects are handled as for environmental issues in general. Implementation of important wildland components should, as a general principle, be well underway before a project's major land clearing or construction works are allowed to proceed.

PHYSICAL INPUTS REQUIRED IN MOST WILDLAND MANAGEMENT AREAS

- a. Headquarters building and guard posts at entry points.
- b. Staff housing.
- c. Visitor information center, including educational and interpretive exhibits where appropriate.
- d. Research facilities, including laboratory and housing for scientists.
- e. Roads and trails (amount will vary according to intensity of management desired).
- f. Fencing and signs, adequate to ensure proper demarcation and to control access.
- g. Communications, internal and external to the WMA: radio, walkie-talkies, mail, and telephone (where appropriate).
- h. Electricity, gas, or other energy systems.
- i. Sewage and waste systems.
- j. Four-wheel drive, motor bikes, or other vehicles.
- k. Boats, outboard motors, and docking facilities, where needed.
- l. Appropriate tools, maintenance equipment, and spare parts.
- m. Fuel.
- n. Management-oriented publications: maps, species lists, pamphlets for visitors, etc.

WILDLAND SURVEY AND MANAGEMENT FORM 20/
(Sample only)

Name of Project:

Expected Appraisal (or other) Date:

Date of this Survey:

Surveyor:

Affiliation:

Methodology(ies) (circle one): Site inspection / Library research / Both /
Other(specify)

1. Specific subcategory(ies) of ecosystem that proposed project will affect: (e.g., tropical semi-evergreen moist forest, salt-marsh, wet savanna)
2. Important environmental and biological features of ecosystem(s):
(e.g., water catchment area for large agricultural valley and habitat for the endangered mountain gorilla)
3. Projected general impact type on ecosystem(s) of proposed project:
(e.g., deforestation, flooding, draining)
4. Proportion (%) of the region's remaining ecosystem(s) (as in #1 above) to be converted (and/or impacted, if different): (e.g., This project will flood about 10% of this country's remaining lowland riparian swamp forest.)
5. Estimated annual rates of attrition of affected ecosystem(s) in this country and historical trend of this rate: e.g., The current annual rate of attrition of [semi-montane forest] is 3% a year. This rate was 0.5% in 1975 and 1% in 1980.)

Maps and more complete reports used or available can be appended or cited.

20/ This type of information is expected as part of identification, and can be used for the project brief. This form can be completed by the government's environmental ministry or wildlife agency, or by the project pre-feasibility team's wildlands specialist.

—
THE WHITE HOUSE
WASHINGTON

11/93

Ecuador—

World Bank
guidelines from
Latin Amer. etc.

— Good for Lat Am
Dermat issues.

— anti-deforestation,
etc.

OFFICE MEMORANDUM

DATE: April 16, 1990

TO: Mr. Alain Thys, Chief, LA4IE

FROM: George Ledec, LATEN *GL*

EXTENSION: 39267

SUBJECT: ECUADOR - Supervision of Emergency Petroleum Reconstruction Project
(Loan No. 2803-EC) and Environmental Reconnaissance of Oil Production
Development Project - Back-to-Office and Full Report

~~CONFIDENTIAL~~

DETERMINED TO BE AN ADMINISTRATIVE

MARKING INITIALS *W/4* DATE: *3/13/2017*

1. As per my February 6, 1990 terms of reference, I was in Ecuador February 12-March 3 for environmental work related to the petroleum sector (which was followed by a mission to Venezuela on other business). During the Ecuador mission, I met with a number of government officials and non-governmental specialists, listed in Annex 3 (some jointly with Mr. Khelil, LATIE), and visited various seismic, exploratory and production drilling, storage, pipeline, and refinery sites in Ecuador's Amazon region. This memorandum outlines my findings and recommendations (see Paras. 69-76 for recommendations on Bank follow-up).

Overview of Key Environmental Issues in Ecuador's Petroleum Sector:

2. Most of Ecuador's ongoing oil exploration and production is in the environmentally very sensitive Amazon region; some environmentally sensitive areas along the coast are also being explored (such as the Awa Indigenous Reserve in Block 4; see Figure 1). The mission found that if oil exploration and development in the Amazon region were done using the best available and economically feasible practices, the environmental impacts would be relatively minor. Although the consumption of petroleum products is not without its environmental costs, the process of finding the oil, extracting it from the Earth, and delivering it to market need not be environmentally very damaging. If done properly, petroleum production is environmentally less damaging than the extraction of most other non-renewable resources (particularly mining).

3. However, the actual situation in Ecuador is very different from the ideal: The best available practices are almost never used, even though the marginal financial costs of doing so would generally be very small. Instead, most petroleum production to date has been characterized by no efforts whatsoever to protect the environment; this is presently the still the case with Petroecuador's field operations, as well as those of most of the dozen or so international oil companies (IOCs) active in Ecuador. (There are a few notable exceptions, mainly in the cases of Petro-Canada and CONOCO, discussed below.) Consequently, the environmental damage from oil development in the Amazon region has been very severe, though mostly preventable.

MAPA PETROLERO DEL ECUADOR

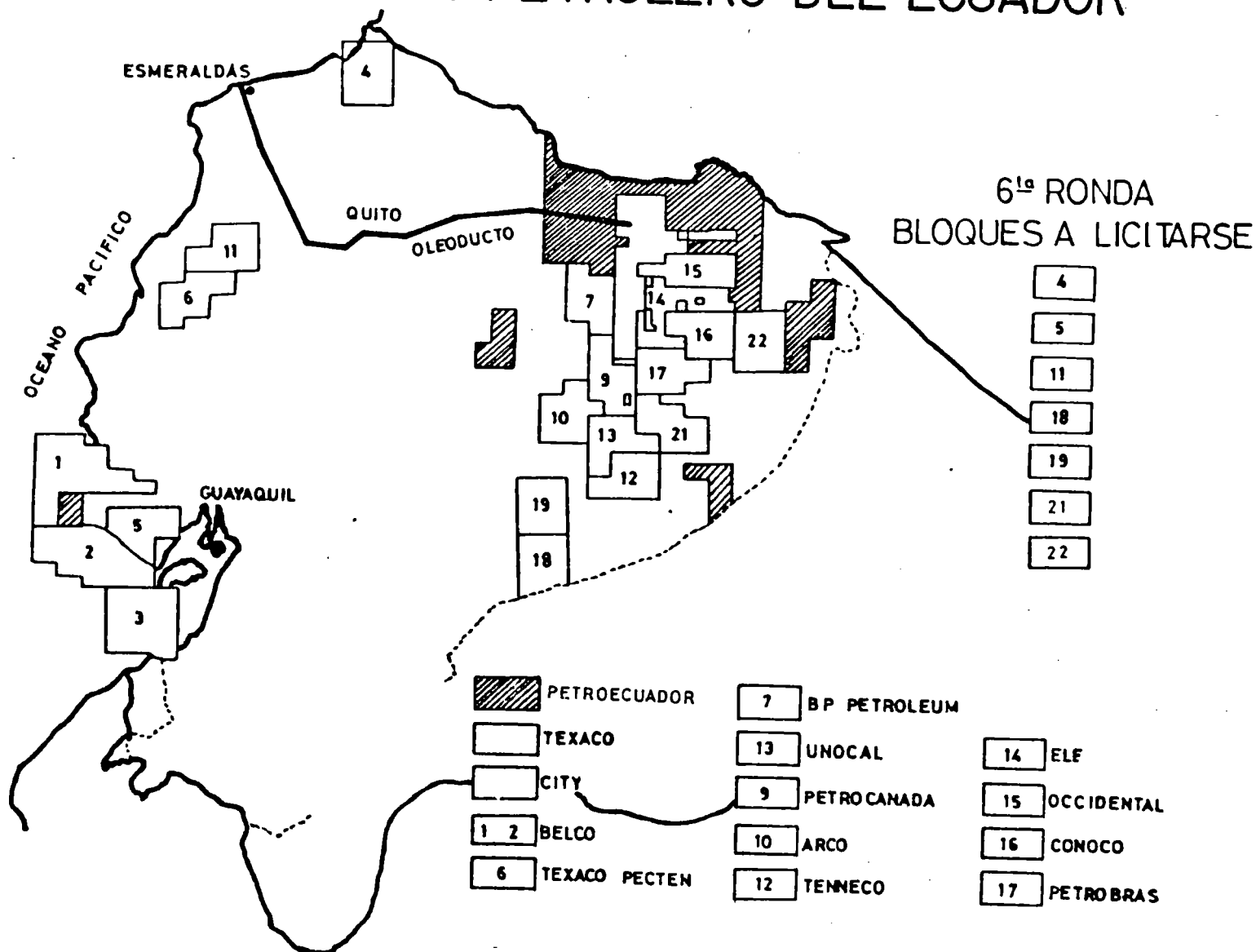


Figure 1.

Colonization Along Oil Industry Roads:

4. By far the greatest environmental impact of oil development in Ecuador's forested regions is the colonization and deforestation that rapidly follows the construction of new oil industry roads. As is detailed in the Bank's recent study (Para. 67), the Amazonian forest areas being opened to colonization by oil industry roads are largely unsuited for sustainable agricultural development, and are more appropriate for the extraction of various forest products (including timber production, if carefully controlled).

5. The pattern of colonization in Ecuador's Amazon region is essentially "linear" in nature, along newly-constructed roads. Depending on factors such as road quality, distance to towns, and topography, roughly between 2 and 12 kilometers (km) along each side of a road are colonized. Largely because of labor constraints, not all of the forest is immediately cleared, although most colonists deforest progressively more of their holdings each year. Thus, a rough rule of thumb would be that (in the absence of effective controls) each kilometer of new road built by the oil industry through forest results in the colonization of 400-2,400 hectares (ha), most of which are eventually deforested. Dr. Fernando Ortiz-Crespo of USAID estimates that the more than 500 km of oil industry roads constructed so far in Ecuador's Amazon region have resulted in the colonization of roughly 1 million ha (perhaps half of which have already been logged or deforested).

6. A lasting solution to the colonization and deforestation problem is beyond the scope of the oil industry, and will require reforms in land titling, agricultural credit, and other policies for the Amazon region (Paras. 60-68), as well as improving the economic alternatives for would-be colonists outside the Amazon region. However, the oil industry needs to do its part to minimize the colonization and deforestation of agriculturally unsuitable areas. There are basically two approaches which the Ecuadorian oil industry can and should use to control deforestation: One is technical in nature; the other is policy-based.

7. The technical approach for controlling colonization is to minimize the kilometers of new roads built by the oil industry. To some extent, this can be achieved by more careful layout of the road system for a new oil development area. For example, had the system of Petroecuador roads built within the Cuyabeno Wildlife Reserve been more carefully planned, the extent of colonization would have been reduced (even without additional colonization control measures).

8. Of even greater value for forest conservation would be the use of cluster drilling platforms, which can hold up to about 10 wells that are "slant-drilled" to reach the petroleum deposits. Under this system, far fewer kilometers of roads are needed, because the wells are not so dispersed, and each well does not require its own feeder road. CONOCO plans to use this cluster drilling technology in its Block 16, which is located largely within the Yasuni National Park. Senior CONOCO officials told the mission that while the investment costs of using the

cluster drilling system are higher, the maintenance and other recurrent costs are lower, so that there is essentially no difference in costs over the life of an oil production operation. This suggests that every new oil production operation in forested areas of Ecuador can and should use this technology, to minimize the kilometers of road built and hectares subsequently deforested.

9. The policy-based approach is to restrict the movement of colonists into forested areas made accessible by those new roads that are built. There is apparently only one example of where colonization along a new oil industry road has been successfully controlled: Block 9, under license to Petro-Canada. In this case, Petro-Canada extended an existing road by about 10 km. through primary forest, and colonization immediately followed. However, Petro-Canada officials negotiated an agreement with the Government, under which the Army maintains a 24-hour roadblock and assists with patrols to prevent further colonization. Those colonists that moved in before this control system was instituted were told by officials of the Instituto Ecuatoriano de Reforma Agraria y Colonizacion (IERAC) that they could not receive land titles, and they were assisted by IERAC in locating alternative lands on which to settle. There are now no colonists now living along this stretch of road, according to Mr. MacIntyre, Resident Director of Petro-Canada. In this case, the fact that this portion of Block 9 is recognized as Waorani (Huarani) Indian territory made it easier for the Government to take strong action to prevent colonization. Thus, the policy-based approach for controlling colonization is probably most promising for designated protected areas, such as National Parks or Indigenous Reserves. In forest areas with no special legal protection, it may be politically more difficult for the Government to prevent colonization of ordinary tierras baldias ("vacant lands").

Formation Water:

10. Aside from colonization, a variety of significant (but mostly preventable) environmental problems arise as direct effects of oil development in the Amazon region. One of these involves formation (produced) water which often accompanies the extracted petroleum. The formation water is oily, often extremely salty, and contains various toxic compounds. The most environmentally sound management of this water is to reinject it into the ground; this is standard operating procedure in many oilfields around the world. However, Petroecuador reportedly still discharges large quantities of untreated and undiluted formation water directly into Amazonian streams and rivers (including areas within the Cuyabeno Wildlife Reserve). Most aquatic life that comes in contact with very salty formation water is killed immediately.

Oil Sumps and Drilling Muds:

11. Another significant environmental problem is the improper management of oil sumps (reserve pits, ponds, piscinas) during exploratory and production drilling. The usual current practice by Petroecuador and the IOCs leaves watery sumps that have toxic drilling

muds at the bottom and a layer of oil on top. Due to the Amazon Region's heavy rainfall, the abandoned sumps often overflow, spilling oil (and sometimes even drilling muds) into adjacent streams and rivers. Even when they do not overflow, the sumps function as a "deathtrap" for many insects, and some birds and mammals, which are attracted to the water and trapped and killed by the surface oil.

12. The environmental problems associated with oil sumps can mostly be prevented, with only minor additional costs. The sumps should be lined (e.g. with plastic, as Petro-Canada has done in Block 9) to prevent or minimize toxic contamination of groundwater by drilling muds. The "middle layer" of water should be piped to a separate sump, from which it can be discharged into waterways after receiving simple treatment (such as aeration spraying, flocculation with compounds such as aluminum sulfate, and dilution with fresh stream water). This would leave the original sump with only a layer of drilling mud, covered by a layer of oil (to the extent that the latter cannot be burned). This pit should then be landfilled; in the case of exploratory drilling, the landfilling should be completed before the wells are abandoned and the on-site bulldozers are removed.

Accidental Oil Spills:

13. Another serious environmental problem is accidental oil spills. Most of these can be prevented through good maintenance and operating procedures, but some (such as the 1987 rupture of the Trans-Ecuadorean Pipeline due to a major earthquake and resulting landslides) cannot. For this reason, oil spill contingency plans (Paras. 16, 19, 21, 69) need to be developed.

Other Environmental Issues:

14. Oil development in Ecuador entails a variety of other environmental problems, which can generally be prevented with minimum additional costs through proper operating procedures. For example, seismic investigations are by themselves environmentally benign, but their environmental impact is greatly increased by illegal oil worker activities, including hunting of protected species and fishing with dynamite. Annex 1 provides recommendations for improving Ecuadorean oil industry operating procedures from an environmental standpoint, during seismic investigations, exploratory and production drilling, transportation, storage, and refining. Another set of major concerns is the effects of oil development on the land rights, livelihoods, and social cohesion of indigenous peoples; these issues are being investigated by Mr. Davis (LATEN) in a separate mission.

Supervision of Loan 2803-EC:

15. The principal environmental activity mandated under the Emergency Petroleum Reconstruction Project (Loan 2803-EC, effective 1987) is the preparation by Petroecuador of an Environmental Management Plan for the

petroleum sector (as per Section 4.03 of the Loan Agreement). After a delay of more than 2 years, Petroecuador has contracted an experienced Colombian consulting firm, AMBIENTEC, to carry out a major environmental study of Ecuador's oil sector and to prepare a draft Environmental Management Plan. Working with Ecuadorean counterpart consultants, the consulting group is known as ESEN-AMBIENTEC, and comprises a team of about 30 professionals, including specialists in water pollution control, petroleum and chemical engineering, biology and ecology, sociology, economics, agronomy, hydrology, geology, and cartography and remote sensing. The study team expects to devote considerable attention to issues of colonization and deforestation, as well as the more direct impacts of oil industry activities.

16. ESEN-AMBIENTEC began work in mid-January 1990; the Project Chief, Ing. Juan David Quintero, is optimistic about completing the planned 10-month study more or less on schedule (i.e., by December 1990). The expected principal outputs from this study are an Environmental Manual of Operations, Oil Spill Contingency Plan, and a detailed background report. A variety of "interim" results, such as detailed maps of ecologically sensitive areas, are to become available well before December 1990.

17. The Environmental Manual of Operations (which may come out in two volumes: "Plan de Accion Ambiental" and "Plan de Control de Efluentes") would specify the practices which Petroecuador and all of its subsidiaries and contractors (as well as all of the IOCs) would need to follow, to minimize the environmental effects from every phase of oil development, including seismic investigations, exploratory and production drilling, pipelines, storage, refineries, and ports. ESEN-AMBIENTEC intend to make the Manual detailed and explicit, so that it would be clear when the oil companies and contractors are, and are not, in compliance. Annex 1 contains the mission's recommendations regarding the environmental concerns which the Manual should address. The Bank should send an approved version of this list to Ing. Quintero, with copies to the appropriate officials in Petroecuador and the Subsecretario de Medio Ambiente (SMA) in the Ministerio de Energia y Minas.

18. No detailed environmental manual for Ecuador's oil industry has yet been put into practice. However, SMA has drafted environmental regulations for the oil industry, entitled Reglamento Ambiental para la Actividad Hidrocarburifera en el Territorio Nacional. These regulations, while far from ideal, can be useful as interim guidelines for Petroecuador and the IOCs to follow, until the Environmental Manual being drafted by ESEN-AMBIENTEC is approved and takes effect. The ESEN-AMBIENTEC Project Chief now has a copy of the draft SMA regulations, and told the mission that the useful elements of these regulations would be incorporated within the forthcoming Environmental Manual.

19. The ESEN-AMBIENTEC Oil Spill Contingency Plan would propose to Petroecuador a program to minimize the environmental damage from accidental oil spills (although these would be kept to a minimum if proper procedures, as recommended in the Environmental Manual, were followed). The Contingency Plan would outline specific technologies and

control systems, sites where control equipment and available personnel should be based, a budget, division of institutional responsibilities, and a schedule for rehearsal of oil spill containment and clean-up operations. It would also provide guidance to Petroecuador on how to administer legal claims for economic damages resulting from oil spills. The Contingency Plan should encompass all Petroecuador (and, if possible, IOC) pipelines and storage facilities.

20. The ESEN-AMBIENTEC report will also contain substantial background information, including detailed maps of the environmentally most sensitive areas (which should be very useful in planning future oil development infrastructure), and an educational video on environmental control in oil industry operations. The report will also include recommendations for long-range monitoring of water quality and forest cover in the Amazon region and in selected sites along the Trans-Ecuadorean Pipeline. Essentially all of the study's recommendations to Petroecuador are expected to include a proposed timetable, budget, and division of institutional responsibilities. Additional details on the ESEN-AMBIENTEC study are contained in their technical proposal, Plan Integral de Manejo Ambiental de la Actividad Hidrocarburifera, of which the mission received one copy.

21. The Bank's leverage (in the form of a proposed new loan, discussed below) should be used to encourage Petroecuador to implement the Environmental Manual, Oil Spill Contingency Plan, and other recommendations (as appropriate) of the Environmental Management Plan being developed by ESEN-AMBIENTEC. For this reason, the Bank should monitor carefully the work done by ESEN-AMBIENTEC, and subsequent follow-up by Petroecuador. The Bank should send to ESEN-AMBIENTEC and Petroecuador officials its comments and recommendations concerning the content of the Environmental Manual (as outlined in Para. 17). The Bank should also comment on drafts (when available) of the Oil Spill Contingency Plan and other aspects of the Environmental Management Plan. The Bank should also encourage Petroecuador to solicit technical comments from NGOs and other interested specialists (including IOC officials) on the Environmental Manual and Oil Spill Contingency Plan, before the final versions are adopted. Petroecuador should make the final, official versions of these documents readily available to IOCs, NGOs, and other interested members of the Ecuadorean public.

22. As part of its study, ESEN-AMBIENTEC is scheduling 4 technical seminars for Petroecuador and other relevant Government officials. The first, held in February, was an introductory, half-day presentation attended by the mission. The second will be a 4-day training workshop for Petroecuador on environmental impact assessment procedures, design of oil spill contingency plans, and treatment of wastewater from refineries; it is tentatively scheduled for mid-May. The third will be a 2-day presentation of the study's preliminary findings and recommendations, tentatively scheduled for the last week of July. The fourth seminar, tentatively scheduled for late October, will be a 1-day presentation of the study's final findings and recommendations; representatives of interested NGOs are expected to attend this final seminar. Interested Bank staff should try to schedule missions to coincide with these seminars; one or more Bank staff members should

ideally be present at each one. It would also be helpful for the Bank to receive from ESEN-AMBIENTEC a brief written report on the study's progress, prior to each seminar.

23. ESEN-AMBIENTEC is receiving generally good cooperation from Government agencies as it carries out its work. However, the Direccion Nacional de Medio Ambiente (formerly DIGEMA, now a major division of SMA) has apparently not been very helpful; for example, it has denied members of the ESEN-AMBIENTEC group access to the Direccion's library of documents. The reason for this seemingly counterproductive stance by the Director General, Ing. Nelson Suquilanda, may be resentment that ESEN-AMBIENTEC received the approximately US\$1 million contract, rather than certain Ecuadorean consulting firms favored by Suquilanda. Aside from the question of which group of consultants could have done the best possible job, the Direccion Nacional's lack of cooperation with ESEN-AMBIENTEC at this stage of the project is unfortunate. It may therefore be helpful for the Bank to send a letter to the Minister of Energy and Mines (with copies to the Subsecretary of Environment, the Director General, and the Project Chief of ESEN-AMBIENTEC), encouraging better cooperation between the Direccion Nacional and ESEN-AMBIENTEC.

Environmental Assessment of Oil Production Development Project:

24. The Bank has identified the proposed Oil Production Development Project as a "Category A" project, which will require the preparation of an Environmental Assessment (EA), as specified in Operational Directive (OD) 4.00.

25. In order to prepare a detailed EA, it is necessary to define fairly precisely the specific components of the project being assessed. As presently proposed, the Oil Production Development Project would provide roughly US\$100 million to finance:

a. New oilfield development by Petroecuador at the northern edge of Block 7, in the Payamino, Coca, Pucuna, and Paraiso oilfields. This development would exploit a "common pool" of oil shared between Petroecuador and the Oryx corporation (which replaces British Petroleum in Block 7).

b. Enhanced oil recovery and rehabilitation of infrastructure in Petroecuador's existing Amazonian oil fields, in areas such as Libertador, Cantagallo, Cuyabeno, and Sansahuari. This may involve the drilling of many new wells, along with the rehabilitation of production facilities, pipelines, and refineries.

c. Seismic data gathering and interpretation for the most promising (in terms of potential oil discoveries), but still unstudied, areas of Ecuador.

d. Appropriate measures for environmental protection and mitigation, and to safeguard the land rights and traditional livelihoods of indigenous peoples.

e. Institutional strengthening (environmental and otherwise) of Petroecuador.

26. Assuming that the proposed Oil Production Development Project indeed has only these major components, virtually all of the technical information needed to prepare an adequate EA is presently being obtained by the ongoing ESEN-AMBIENTEC study. The geographical focus of the ESEN-AMBIENTEC study encompasses most of the present and potential oil-producing areas in northeastern Ecuador, as well as the area of influence of the Trans-Ecuadorean Pipeline, Esmeraldas refinery, and Balao port facilities. This therefore includes Petroecuador's existing Amazonian oil development areas (where enhanced recovery and rehabilitation are planned), as well as all of Block 7. The ESEN-AMBIENTEC study is identifying environmentally highly sensitive areas throughout the study area; Petroecuador can readily adapt this information in discussing potential environmental impacts in the EA. ESEN-AMBIENTEC are also developing a comprehensive Environmental Manual of Operations and Oil Spill Contingency Plan (Paras. 17, 19); Petroecuador should be able to use these to select the environmental protection and mitigation measures specifically needed for the proposed Bank-supported project. The proposed project would probably also support seismic studies in parts of Ecuador not specifically included within the ESEN-AMBIENTEC study. However, following the requirements of the Environmental Manual (such as those indicated in Annex 1) should be sufficient to avoid any significant environmental damage from seismic studies, regardless of the location.

27. Because the ESEN-AMBIENTEC study (if carried out as planned) will develop virtually all of the technical information needed for a proper EA of the Oil Production Development Project, it should not be necessary for Petroecuador to hire another group of consultants specifically to prepare the EA. Rather, the staff of Petroecuador's environmental unit should be able to prepare a draft EA in-house, by extracting and compiling relevant information from the ESEN-AMBIENTEC reports. It is important for Petroecuador's environmental unit to be able to prepare, in a routine and efficient manner, environmental assessments of new oil development infrastructure, whether or not it is Bank-financed. For Petroecuador to develop this in-house environmental assessment capability over the long term, institutional strengthening is required (see Paras. 51-57).

28. Annex 2 contains draft terms of reference for Petroecuador to carry out an EA report for the proposed Oil Production Development Project. The Bank should urge Petroecuador to initiate work on the EA immediately, since much of the work can be done before the broader ESEN-AMBIENTEC study is complete.

29. In accordance with OD 4.00, Petroecuador should implement formal mechanisms for participation by interested Government agencies and non-Governmental entities in the EA process. The suggested approach (detailed in Annex 2) is for Petroecuador to convene 5 meetings: One each for Governmental and non-Governmental entities to provide comments during the early stages of the EA process, one jointly for both groups to give a "mid-term progress report", and one each for Governmental and

non-Governmental entities to comment on the complete draft EA. Bank staff (including the Project Task Manager, when feasible) should endeavor to schedule missions to coincide with these meetings.

30. Assuming that ESEN-AMBIENTEC complete their work on schedule (by the end of 1990) and that Petroecuador undertakes much of the EA work before ESEN-AMBIENTEC's reports are finalized, it might be reasonable for Petroecuador to complete a draft EA by March 1, 1991. The Bank's appraisal therefore could be accelerated to begin around March 1991 (upon receipt of a complete draft EA from Petroecuador), if:

a. The other important environmental conditions (outlined in Para. 69) are met;

b. The necessary work concerning indigenous peoples can be completed; and

c. The other (non-environmental) project components are ready for appraisal.

31. To comply with OD 4.00 (Para. 22 of the OD), the Bank should not complete appraisal until it reviews a satisfactory final EA. This EA should receive clearance from the Environmental Subsecretariat (SMA--see Paras. 61-62), and should incorporate the comments of other Government agencies, NGOs, and other interested parties. The process of finalizing the EA (including obtaining clearance from SMA and soliciting, receiving, and incorporating the comments of other Government agencies and non-Governmental entities) need not take more than 2 months. To minimize possible delays in Project processing, the Bank's review of Petroecuador's draft EA should occur concurrently with the reviews by SMA, other Government agencies, and non-Governmental groups. Ideally, the Bank's appraisal mission should coincide with the Governmental and non-Governmental meetings convened by Petroecuador to receive comments on the draft EA.

32. To expedite the EA process, it seems desirable for the Bank to send a detailed letter or other communication to the Executive President of Petroecuador, outlining:

a. The specific Project components that the Bank would be willing to finance;

b. The proposed timing of project preparation, appraisal, and implementation;

c. Terms of reference for the EA (an approved version of Annex 2, attached to the letter) which the Bank will require prior to appraisal; and

d. Recommending that Petroecuador initiate the EA process in earnest, working closely with the ESEN-AMBIENTEC team to select and compile the necessary technical information.

Management of Tropical Forests and Protected Areas:

33. The new Oil Production Development Project should minimize damage to any forested areas (such near Block 7, or new well sites within existing Petroecuador oil development areas) by adopting all feasible environmental protection measures, as outlined in Paras. 7-14 and Annex 1. If any of the Project-related areas have special legal protection (such as Bosques Protectores or indigenous reserves), the Project should support colonization control measures, including 24-hour roadblocks and routine patrols. Any new production wells drilled in forested areas should be "clustered" (as described in Para. 8), in order to minimize the construction of access roads. The actual components needed to prevent or mitigate environmental damage from all of the new, Project-financed infrastructure should be specified in Petroecuador's EA of the Project (Paras. 24-28; Annex 2).

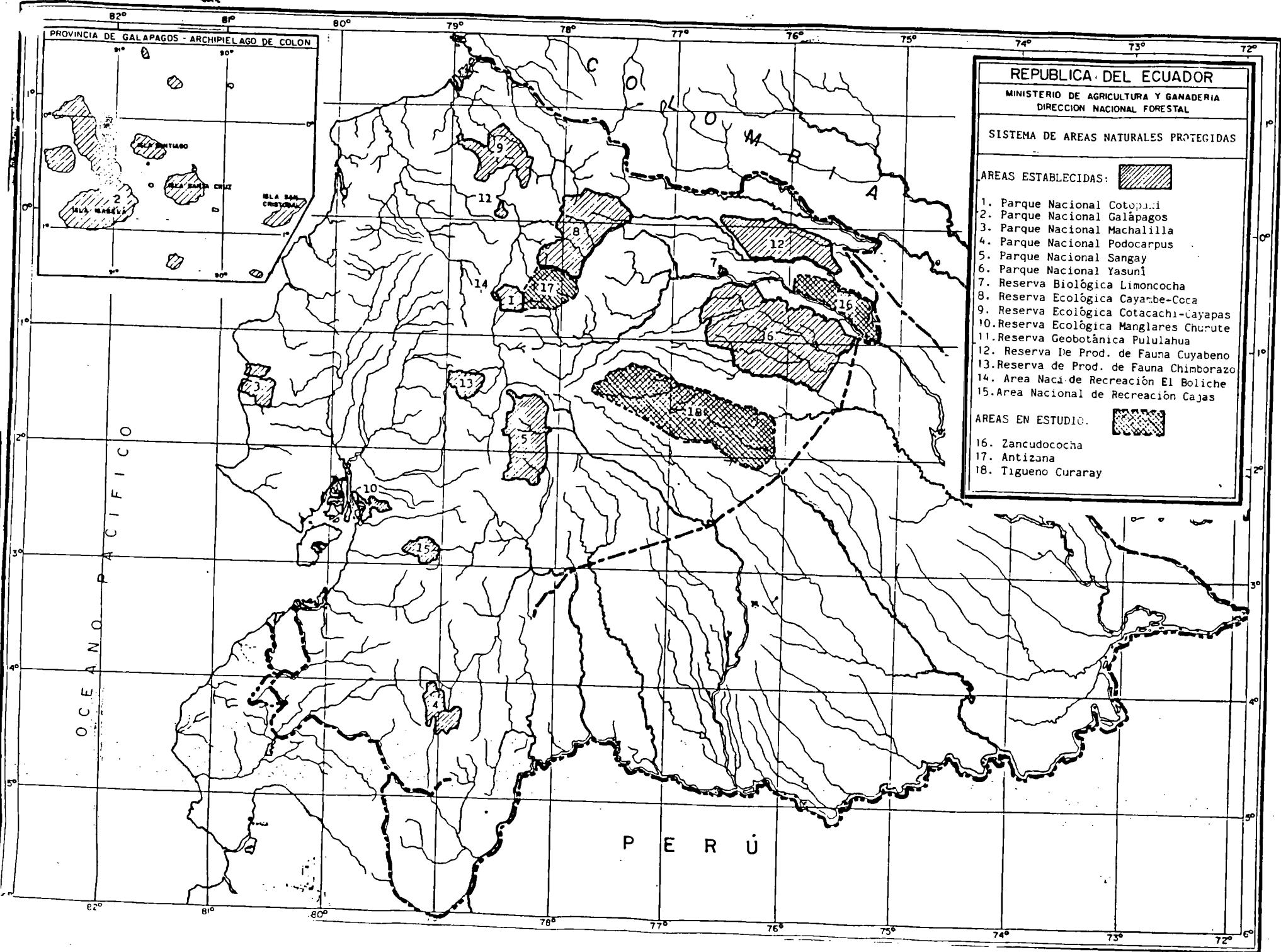
34. The Oil Production Development Project also needs a component to improve the on-the-ground management of certain legally protected areas. The Bank has a strong policy of supporting protected areas to compensate for wildlands lost or damaged through development projects, as outlined in OPN 11.02, Wildlands: Their Protection and Management in Economic Development (to be reissued as OD 4.00, Annex D). Figure 2 is a map of Ecuador's present and officially proposed National Parks, Wildlife Reserves, and equivalent "strictly" protected areas (not including Bosques Protectores, such as Volcan Sumaco, which receive less strict legal protection and permit more "multiple use"). As is discussed below, many of these areas are affected by oil industry activities. These areas, if adequately protected, would help to compensate for the loss of, or damage to, other (non-protected) forested areas by oil development.

Cuyabeno Wildlife Reserve:

35. The Ecuadorean protected area most seriously damaged to date by oil development and related activities is the 254,760-ha Cuyabeno Wildlife Reserve, established in 1979 (Figures 3 and 4). As a result of large-scale road construction by Petroecuador, coupled with a lack of effective protection by the Direccion Nacional Forestal (DINAF, under the Ministerio de Agricultura y Ganaderia, MAG), as many as 1,000 families of colonists have now settled within the Reserve. Some 25-40 percent of the Reserve (mostly the western portion) has now been affected by colonization. Because the Reserve still lacks adequate protection and boundary demarcation, more colonists are continuing to enter (according to officials of Fundacion Natura, Ecuador's leading environmental NGO).

36. The Cuyabeno Reserve has a detailed, written Management Plan, produced in December 1987. The Plan recommends a variety of measures to ensure proper protection of the Reserve. To resolve the problem with the existing colonists, the Plan proposes that each family be given special land titles of about 20 hectares, with the stipulation that the land could never be sold (and would revert to the Reserve if abandoned), and that the colonists would collaborate with Reserve staff in

Figure 4.



preventing additional colonization. The Plan also recommends the expansion of the Reserve to the east (encompassing about 150,000 ha), to compensate for the colonized area in the western portion (which would be officially downgraded to a Reserve "buffer zone"). The Plan also specifies a variety of investments and recurrent expenditures (discussed below) necessary for proper protection of the Reserve. However, most of the recommendations of the Management Plan have not yet been implemented. This has been due mostly to DINAF's general institutional weakness and severe shortage of funds.

37. The Cuyabeno Reserve has also been significantly damaged by oil pollution. Some of the oil industry's environmentally most careless practices (as discussed in Paras. 3-14 and Annex 1) are standard operating procedures in Cuyabeno. In November-December 1989, a large oil spill seriously contaminated 14 or more lakes within the Reserve; because of the slow-flowing water, much of the oil has remained in the area, impeding natural recovery. Petroecuador reportedly made no efforts to contain or clean up the spill. Besides causing major wildlife mortality, this and other spills have contaminated water supplies used by the Siona-Secoya Indians who live within the Reserve. The Siona-Secoya people recently reported health problems related to the use of oil-polluted water, but were not provided any medical or other assistance by Petroecuador (according to DINAF officials).

38. Because the Cuyabeno Wildlife Reserve is the one protected area in Ecuador that has been most seriously degraded by the activities of Petroecuador, the proposed Oil Production Development Project should include a component for the Reserve's increased protection and environmental rehabilitation. This component should include the following elements:

a. Petroecuador would initiate improvements in its operating practices within Cuyabeno as a matter of priority; significant improvements in operating procedures, based on the new Environmental Manual, should already be evident as a condition of appraisal. Petroecuador would be expected to follow strictly the new Environmental Manual for all of its operations within the Cuyabeno Reserve.

b. The loan would finance a variety of investments needed to implement the Cuyabeno Management Plan and ensure the Reserve's proper protection. These investments would be based on the recommendations of the Management Plan, and could include proper boundary demarcation, control posts and living quarters for additional park guards, one or more visitor centers, 4WD vehicles, motorcycles, boats and outboard motors, and environmental education materials (such as posters and videos) for local communities. Because time is of the essence in providing adequate protection for Cuyabeno (since delays imply that more colonists will enter the Reserve and clear the forest), some of these investments should ideally begin before loan effectiveness; they could be financed retroactively from the new loan, with undisbursed funds remaining from Loan No. 2803, or possibly through some other mechanism.

c. The Bank should also support (as a condition of loan effectiveness, if needed) the proposed expansion of the Reserve's

boundaries to the east (as indicated in Figures 3 and 4), which would help to compensate for the colonization and partial deforestation of the Reserve's western portion. This boundary expansion would require only a ministerial decree from MAG; it would not require new legislation or Presidential action.

39. The Bank can encourage prompt action on the Cuyabeno component by:

a. Requesting Petroecuador to make the environmental improvement of operating procedures within the Cuyabeno Wildlife Reserve a high priority, and indicating that significant progress in this area will be a condition of appraisal for the Oil Production Development Project; and

b. Requesting DINAF to prepare a proposal for investments that would be needed to ensure adequate protection and environmental management of the Reserve. The proposal should distinguish between (1) investments that are immediately needed to stabilize the colonization problem (such as boundary demarcation and guard posts) and should ideally be financed before the new loan becomes effective, and (2) longer-term investments (such as visitor centers and environmental education materials) which can be initiated during Project implementation. Such a proposal, along with a timetable of activities and budget, could be readily derived from the existing Cuyabeno Management Plan. Because of DINAF's institutional weaknesses, it may be important for Fundacion Natura to provide some technical assistance in the development of the proposal. The "immediate" activities should then be initiated (before regular Project implementation) through a convenio between Petroecuador (which would provide financing), DINAF (the executing agency), and (as needed) Fundacion Natura, IERAC, and/or the Army. (IERAC is legally responsible for the demarcation of all lands, including the boundaries of protected areas; the Army may be needed initially to back up DINAF park guards, who may not otherwise command sufficient respect from would be colonists.) The longer-term, less urgent investments would be initiated during Project implementation, under a similar convenio. (See Paras. 47-51 for a discussion of recurrent costs.)

Yasuni National Park:

40. Unlike the Cuyabeno Wildlife Reserve, the 679,730-ha Yasuni National Park (also an international Biosphere Reserve) is still in a near-pristine state. Aside from oil workers, the Park still has essentially no human habitation except for several groups of Waorani Indians, whose traditional livelihoods (based mostly on hunting and gathering) are compatible with the survival of the forest ecosystem. The Park overlaps with Blocks 14 (Elf Aquitaine), 15 (Occidental), 16 (CONOCO), 17 (Petrobras), and 22 (open for Sixth Round bidding in April 1990). (See Figures 1, 3 and 5.) While CONOCO, Elf Aquitaine, Occidental, and Petrobras have all conducted exploratory drilling in their blocks, only CONOCO currently plans to proceed with production drilling for ca. 150 million barrels of commercially recoverable heavy crude.

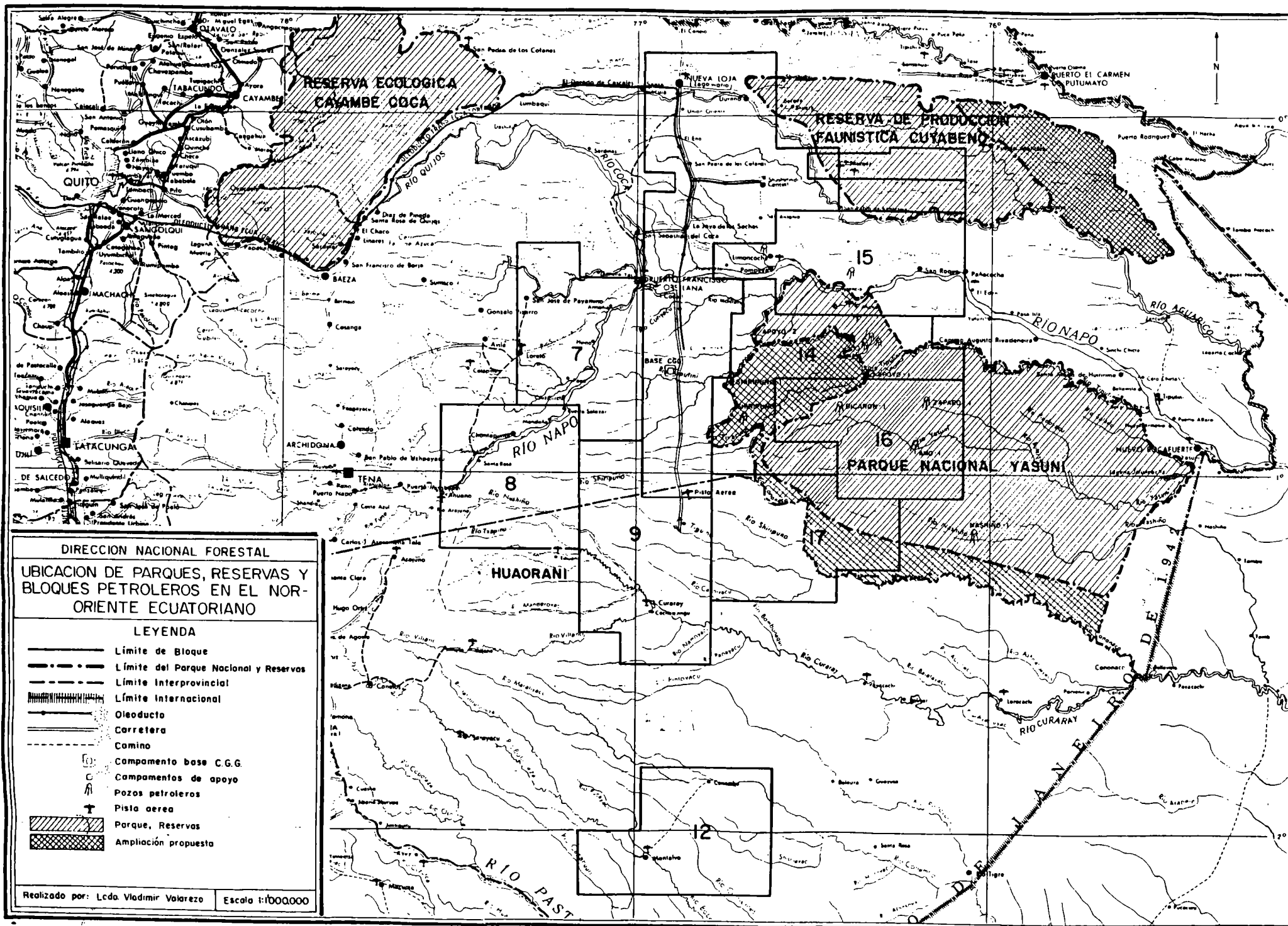


Figure 4.

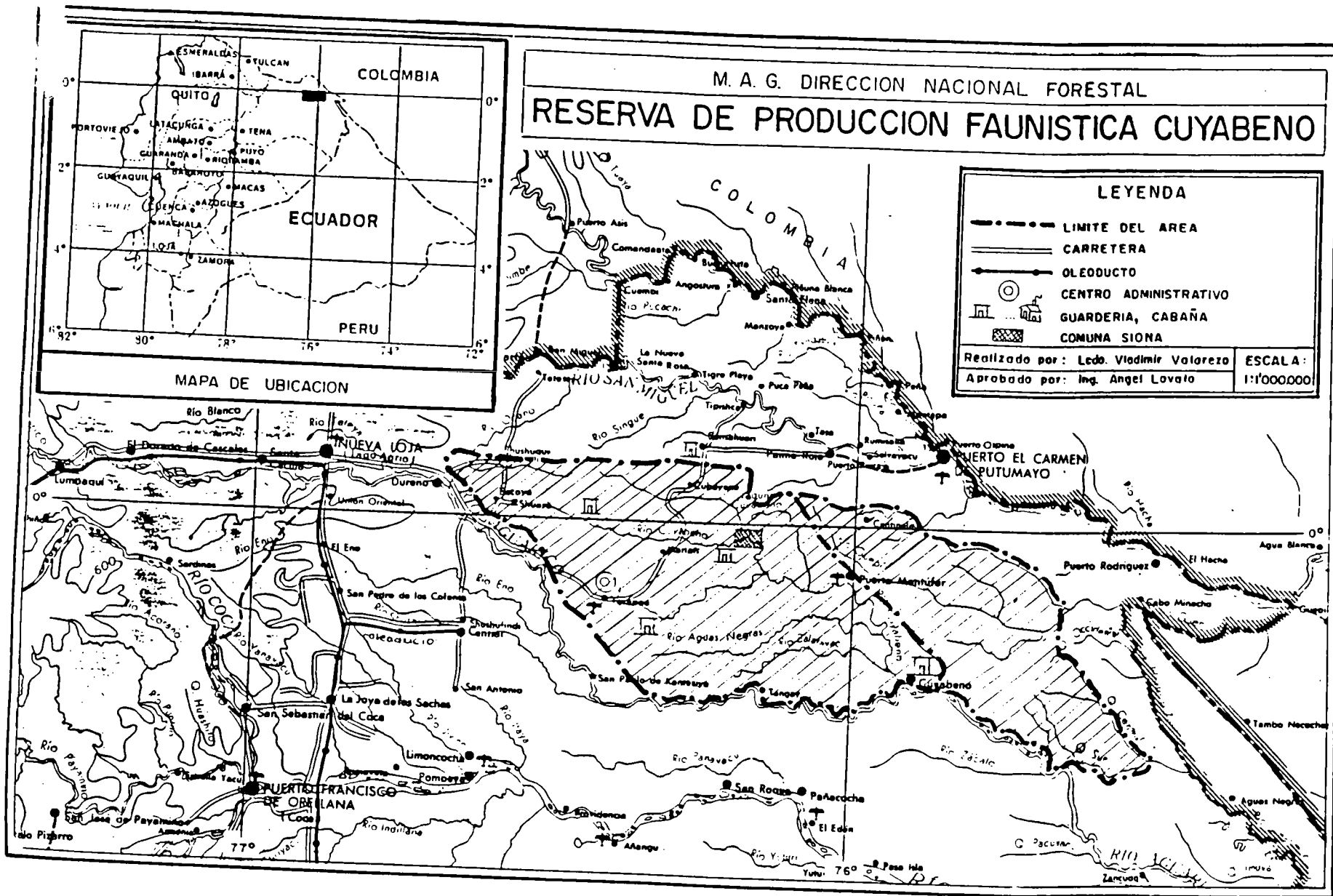
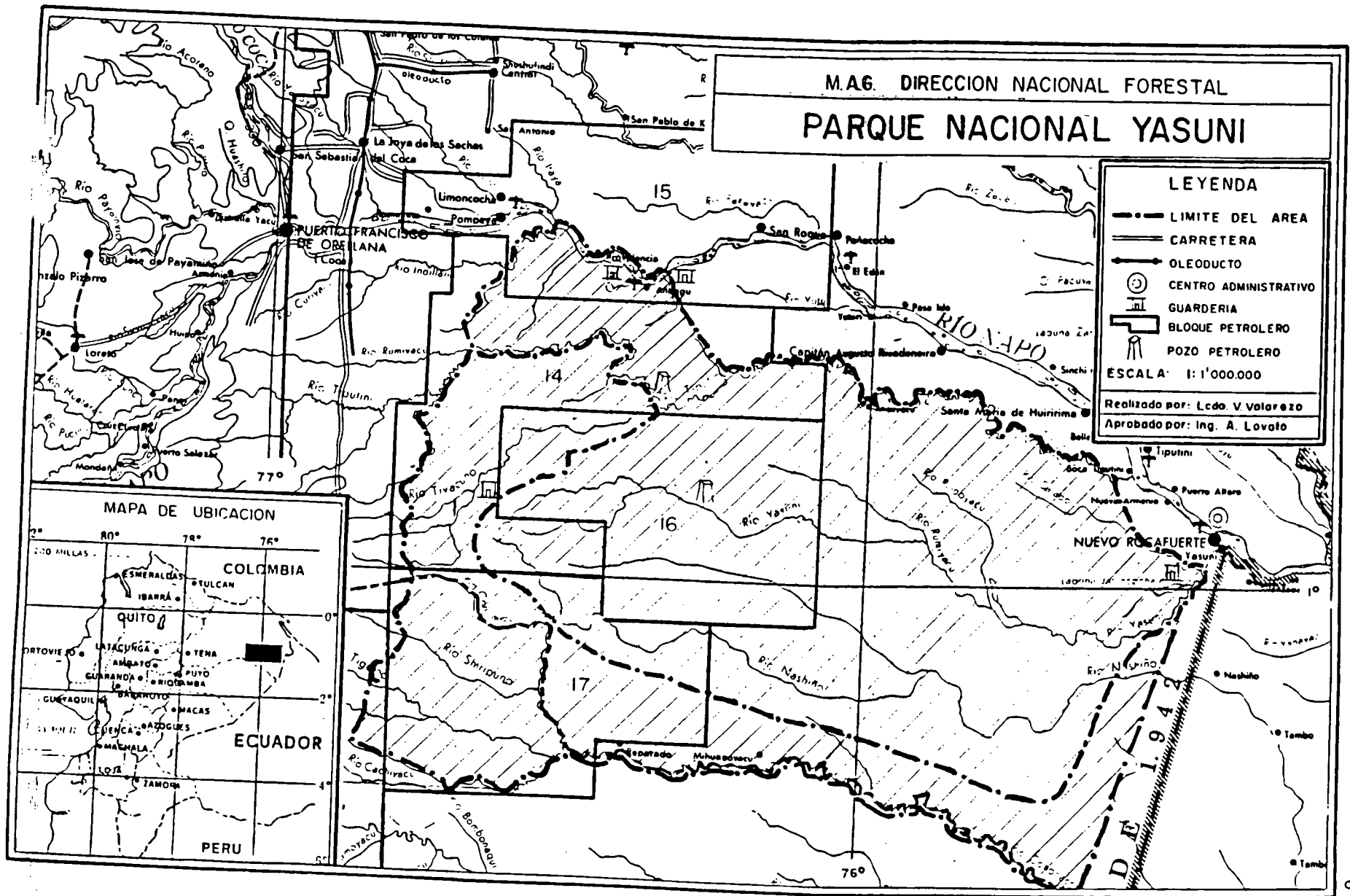


Figure 5.



41. Oil development within the Yasuni Park is highly controversial with environmental NGOs, both Ecuadorean and international. A group of Ecuadorean NGOs, led by the Corporacion de Defensa de la Vida (CORDAVI), has filed a lawsuit with Ecuador's Tribunal de Garantias Constitucionales (supreme court) to block the Sixth Round bidding on Block 22. Petroecuador officials expressed optimism to the mission about winning this legal case. In any event, given the Government's very high economic dependence on petroleum exports, preventing oil development in Yasuni or any other protected area appears politically unlikely. (It is difficult enough for environmentalists in a country as wealthy as the United States to prevent oil development in Alaska's Arctic National Wildlife Refuge.)
42. CONOCO officials point out that they were never informed, prior to bidding, that Block 16 lies within the Yasuni National Park. It will thus be revealing of Petroecuador's environmental focus to learn whether the upcoming Sixth Round bidding documents for IOC concessions indeed mention that Block 22 also lies within the Yasuni National Park, Block 4 overlaps with the Awa Indigenous Reserve and a biologically unique area of coastal forest, and Block 5 abuts the Manglares Churute Ecological Reserve.
43. Within the Yasuni Park, CONOCO plans to lay a 14" diameter pipeline for the heavy crude, alongside smaller pipelines for light crude (which would be piped in for dilution of the heavy crude), natural gas, and diesel. According to CONOCO officials, the process of constructing these pipelines (particularly the 14" line) necessitates a road or wide track usable by the side-boom tractors which are used for lifting sections of pipeline into place. Therefore, even using large helicopters to bring the pipeline sections into place would not obviate the need for some type of road. CONOCO officials also seem unwilling to decommission the road (e.g. by removing the bridges) after the pipeline is operational.
44. CONOCO's planned pipeline and associated road through the Yasuni National Park would go north to the Napo River, which will be more of a barrier to colonization than if the pipeline were to go west to connect with the existing "Los Aucas" road to Coca (as originally planned). Nonetheless, a strong system of Park protection will need to be in place to prevent colonization and deforestation along the CONOCO road, the construction of which is scheduled to begin within several months. As with Cuyabeno, DINAF has official responsibility for the protection of Yasuni National Park from colonization or other environmental damage. However, DINAF is presently a weak agency with a very limited budget, staff, and implementive capability.
45. On the other hand, the Fundacion Natura has considerable budgetary resources available (as the result of a recent debt-for-nature swap) to initiate the proper protection of Yasuni, through on-the-ground demarcation; establishment of guard posts; hiring of park guards; provision of vehicles, boats, motors, radios, and other necessary equipment; and other Park protection investments. In the short term, the main difficulty may well be the institutional rigidity and slowness of DINAF in properly making use of the funds which are available through

Fundacion Natura. Coordination will also be necessary with IERAC, and perhaps with the Army. It is therefore important for CONOCO to coordinate the timing of its Yasuni pipeline road construction carefully with the implementation of Park protection measures, so that the road (or even road survey markers, which colonists follow) not be in place before the necessary protective measures.

46. CONOCO officials told the mission that their development of Block 16, including all of the pipelines and associated road, is being done entirely with private financing, and independently of any infrastructure that might be built by Petroecuador. If this is indeed the case, then the Bank can legitimately claim not to be involved with the publicly controversial Yasuni oil development. Nonetheless, the proposed Oil Production Development Project should contain a component for financing necessary Park protection investments, if those being financed through Fundacion Natura prove to be insufficient. This should become more evident by late 1990, prior to appraisal.

Financing Protected Areas' Recurrent Costs:

47. Besides Cuyabeno and Yasuni, the following other protected areas in Ecuador are presently or potentially affected, to some degree, by oil industry activities:

a. The Limoncocha Biological Reserve (4,613 ha, established 1985) has undergone exploratory drilling, with some damage to waterways from improperly discharged oil and contaminated water. No production drilling is planned. There is colonization nearby, but reportedly not within this relatively small Reserve.

b. The Cayambe-Coca Ecological Reserve (403,103 ha, established 1970) has some illegal colonization related to the Quito-Lago Agrio highway, which borders the southern and eastern margins of the Reserve; this highway was built as a service road for the Trans-Ecuadorean Oil Pipeline. (The proposed Antisana protected area would also abut a portion of the Quito-Lago Agrio road.) A Petroecuador camp (Bermejo) reportedly lies within the Cayambe-Coca Reserve.

c. The coastal Machalilla National Park (46,683 ha, established 1979) is apparently threatened by a new Petroecuador pipeline (Libertad-Monteverde-Manta) and associated road.

d. The Manglares Churute Ecological Reserve (35,032 ha, established 1979) is adjacent to Block 5, which is available for bidding by IOCs. This Reserve would receive support for its strengthened protection under the proposed Bank-financed Lower Guayas Flood Control Project.

e. The world-famous Galapagos National Park (693,700 ha, established 1936) is Ecuador's best known protected area, and a major focus of Ecuador's tourist industry. The Park receives very good on-the-ground management, compared with Ecuador's mainland protected areas. However, Petroecuador plans to construct a gasoline storage terminal on

the Island of Baltra. Great care will be needed to prevent potentially serious water pollution problems from this facility.

f. The proposed Zancudococha and Tigueno Curaray protected areas also overlap with probable future oil exploration or development areas.

48. Even though funds for necessary investments are often lacking (as in the case of Cuyabeno, discussed above), the most critical constraint to proper on-the-ground management of most of Ecuador's protected areas is the shortage of recurrent cost financing. Important recurrent costs for protected area management include the salaries of park guards and other staff, fuel, spare parts, and field travel expenses (viaticos). Because the Ecuadorean oil industry affects a sizable number of protected areas, it is important to dedicate some (relatively very small) proportion of industry revenues to a Protected Areas Fund that could be used to support the recurrent costs of proper management for these areas. Such a Fund would compensate for the oil industry's disturbances to the legally protected areas, thereby helping to internalize an environmental externality. As such, the Fund would not represent arbitrary "earmarking" of Petroecuador revenues, which the Bank has traditionally (and justifiably) opposed.

49. The proposed Protected Areas Fund should be financed by dedicating a small fraction (either a percentage or a fixed amount, adjusted for inflation) of Petroecuador's revenues to the Fund. The IOCs should also be asked to contribute a predetermined amount each year to the Fund. Such contributions could be voluntary to accomodate existing IOC contracts, but should be mandated in new contracts. (It seems likely that at least some of the IOCs would want to make voluntary contributions, at least for public relations purposes.) The ideal amount of the Fund (perhaps about US\$300,000/year) could be calculated by adding up the recurrent cost requirements for proper on-the-ground management of Cuyabeno, Yasuni, and the other mainland protected areas listed in Para. 47. The Fund could be administered under a convenio between Petroecuador and DINAF and/or Fundacion Natura.

50. The new Petroecuador Law (Ley Especial de la Empresa Estatal Petroleos del Ecuador y sus Empresas Filiales) indicates that up to 2.5 percent of Petroecuador's annual investment budget (which is to be at least 40 percent of Petroecuador's revenues) can be devoted to environmental expenditures. This provides sufficient legal scope for financing a Protected Areas Fund from Petroecuador revenues. Petroecuador is also considering charging each IOC US\$100,000 per year (in future contracts) to finance various environmental mitigation activities.

51. The Bank should strongly encourage Petroecuador to build on these initiatives by establishing a specific Protected Areas Fund, which would finance some or all of the recurrent costs of properly managing those protected areas which are affected by oil industry activities. Ideally, creation of this Fund should be a condition of appraisal of the Oil Production Development Project; effective operation of the Fund should be a condition of disbursement.

Environmental Institutional Strengthening of PetroEcuador:

52. Notwithstanding its poor performance to date in terms of environmental management, Petroecuador is now seeking to improve both its record and its image. The agency created a new Environmental Unit (Unidad de Proteccion Ambiental) in December 1989. The Environmental Unit appears to be well-situated in Petroecuador's organizational chart, answering directly to the Executive President (along with the Solicitor (Procuraduria) and Institutional Relations units). The new Chief of the Environmental Unit, Lic. Manuel Navarro, appears very interested in making the Unit function effectively. Nonetheless, the Environmental Unit is presently still very weak, with inadequate staff and technical environmental expertise. To enable Petroecuador to carry out proper environmental practices in all of its operations, major institutional strengthening of the Environmental Unit is essential. Petroecuador officials told the mission that they would welcome Bank assistance in this regard.

53. Petroecuador's Environmental Unit presently has 9 professional or technical staff. Of these, 6 are currently on loan to ESEN-AMBIENTEC for the duration of the study, and are therefore unavailable for most operational duties. Lic. Navarro is interested in expanding the Environmental Unit's staff to about 30 persons, which should mostly be hired from outside of Petroecuador (because in-house environmental expertise is lacking). However, a major staffing increase for the Environmental Unit has not yet been approved by Petroecuador's Executive President. Ideally, the Environmental Unit should have enough staff to enable them to carry out effectively all necessary functions, including:

- a. Environmental input into the planning and design of major new infrastructure built by Petroecuador;
- b. Performing routine and practical environmental assessments of all major new Petroecuador infrastructure (even when it is not Bank-financed);
- c. Environmental clearance of all relevant Petroecuador operations, and all major new infrastructure planned by the IOCs;
- d. Proper environmental management, control, and supervision of all field operations. Preliminary estimates suggest that 14 environmental field coordinators should be hired to ensure adequate attention to environmental concerns in Petroecuador's diverse field operations. (There are presently none.);
- e. Environmental supervision of IOC field operations;
- f. Environmental rehabilitation of areas damaged by previous oil development; and
- g. Monitoring of water quality, forest cover, and other environmental indicators in priority areas.

54. To function effectively, the present staff (and, to some extent, new staff) of Petroecuador's Environmental Unit will require considerable environmental training. Fortunately, several training activities for Environmental Unit staff are already underway, planned, or proposed. These include:

a. Six staff of the Unit have been assigned to work as counterparts with the ESEN-AMBIENTEC consultant team, for the duration of the study.

b. ESEN-AMBIENTEC will conduct a 4-day short course on environmental assessment and mitigation in the oil sector, specifically for Petroecuador and SMA staff. (This will comprise their second technical seminar, planned for May.)

c. Petro-Canada's planned technical assistance for the "pilot" clean-up of certain Petroecuador oilfields (Para. 57) will provide a useful training opportunity for Petroecuador staff.

d. SMA (Mr. Luzuriaga) has offered to loan several staff to Petroecuador for about the next year. The SMA staff (who presently are relatively more knowledgeable about environmental issues) would provide in-service training to the staff of Petroecuador's Environmental Unit, while assisting with specific tasks (including possibly the EA required for the proposed new Bank loan).

55. A variety of additional environmental training activities for Petroecuador staff should be supported as a component of the Oil Production Development Project. These could include:

a. Participation in special courses, in Ecuador and overseas, on environment-related topics. One possible institution for overseas training is the Center for Environmental Management and Planning of the University of Aberdeen, Scotland, which offers several courses of about 1, 3, and 6 months' duration in environmental assessment and mitigation techniques.

b. Visits to other countries for relevant conferences and special study tours, as opportunities arise. (One example of such a conference is the First International Symposium on Oil and Gas Waste Management Practices, sponsored by the U.S. Environmental Protection Agency, in New Orleans, September 10-13, 1990.)

c. Brief seminars and workshops (lasting a few hours or 1-2 days) for "non-environmental" Petroecuador staff, to raise their awareness of environmental issues, and the situations in which these issues arise. These could be conducted by Environmental Unit staff, backed up by invited outside speakers.

d. For the most promising Environmental Unit staff, scholarships for masters' or other degrees in environmental sciences, particularly at foreign universities.

56. The Bank should request that Petroecuador approve, as a condition

of appraisal, a plan for adequate staffing of the Environmental Unit (Para. 53); these staff should be hired and functioning as a condition of disbursement. The Bank should also ask Petroecuador to prepare a 5-year environmental training program for its staff (based on the above-mentioned and possibly other options), which would be financed under the Oil Production Development Project. A preliminary training program should be outlined prior to Project appraisal. The staff of ESEN-AMBIENTEC have indicated their willingness to assist Petroecuador, as needed, in preparing such a training program; Bank staff could also assist to some extent in this regard during forthcoming preparation or pre-appraisal missions. The Bank should also encourage Petroecuador to commence with certain training activities this year, before loan effectiveness; these could be financed retroactively from the new loan, or with some of the remaining undisbursed funds from Loan No. 2803.

57. Petroecuador's Environmental Unit also plans to undertake this year two major, remedial environmental "pilot projects". One would be environmental rehabilitation and clean-up of certain oilfields (such as Sacha), where oil pollution due to improper techniques or inadequate equipment is particularly severe. Petro-Canada has offered to provide free environmental technical assistance for this activity, and Texaco will be required to pay a share (reportedly 37.5 percent) of the investment costs. The other pilot project would be environmental rehabilitation of the Esmeraldas refinery complex, which is causing serious pollution of a coastal lagoon, with many complaints from local people. The Bank should strongly encourage Petroecuador to carry out these pilot projects, which could also be financed from undisbursed funds in Loan No. 2803, or retroactively under the proposed new loan. In the case of the oilfield clean-up pilot project, the Bank should recommend that the project be expanded to include high-priority areas within the Cuyabeno Wildlife Reserve (Paras. 35-39).

58. Although a detailed investigation of legal issues was not possible during the mission, it appears that Petroecuador could implement all of the recommendations in this report under the existing legal framework. Nonetheless, environmental strengthening of the Ley de Hidrocarburos and/or the Ley Especial de Petroecuador y Sus Empresas Filiales would be useful, since these laws' present environmental language is rather vague. Thus, if the Bank were to encourage any additional changes in petroleum-related laws (or in their implementive regulations), it would be helpful also to promote more specific environmental language.

Environmental Monitoring and Supervision:

59. There is a critical need for environmental monitoring and supervision of oil industry field operations. No matter how good the Environmental Manual (now in preparation) may become on paper, proper monitoring is essential to ensure that its regulations are strictly and routinely followed. There exists a major gap between the (presently very inadequate) environmental rules that exist on paper for the oil industry, and actual operating practices in the field. As an example, officials of Elf-Aquitaine assured the mission that they strictly prohibit all hunting by oil workers or contractors. However, the

mission found seismic workers in Block 14 cooking a leg from a recently-killed deer; there were also discarded carapaces from previously-consumed turtles. Aside from a mild oral reprimand, the workers were not punished in any way, and the illegal game meat was not confiscated.

60. The primary responsibility for ensuring effective implementation of the future Environmental Manual is expected to rest with Petroecuador's Environmental Unit. The Unit would manage the environmental aspects of all Petroecuador field operations, as well as supervising (to some degree) the environmental aspects of IOC operations. However, there is also a need for independent environmental monitoring of the work of Petroecuador and the IOCs. This is because some inherent conflict of interest exists whenever an agency is required "to police itself". For example, the recommendations of Petroecuador's Environmental Unit (no matter how sound they may be) could still be overruled by Petroecuador's senior management.

61. The main Government agency which legally has a "watchdog" function over the oil industry is the Environmental Subsecretariat (SMA) in the Ministry of Energy and Mines. Recently elevated from the status of a Direccion General (DIGEMA), SMA is attempting to adopt a more effective role in environmental regulation of the oil industry. The Bank plans to support institutional strengthening of SMA through two proposed new loans, Lower Guayas Flood Control (FY 90) and Environmental Institutions (FY91) (particularly the latter). Such strengthening of SMA should improve its role of independent environmental monitoring of Petroecuador and the IOCs, thereby facilitating effective implementation of the environmental components of the Oil Production Development Project.

62. SMA has legal responsibility for environmental regulation of the oil industry (as well as other sectors). SMA has asked Petroecuador and the IOCs to carry out environmental impact studies of planned new oil development activities. Compliance has been spotty; some of the IOCs have done some of the required studies, while other IOCs and Petroecuador have not done any. SMA should ideally have an environmental clearance function over major new oil development infrastructure (such as roads, wells, pipelines, storage tanks, and refineries), whether these are planned by Petroecuador or by IOCs. Environmental clearance of proposed new development projects is now a routine procedure in many countries, including some in LAC. In those (probably few) cases where SMA might deny permission for the new infrastructure on environmental grounds, only high officials (such as the President of the Republic, or possibly the Minister of Energy and Mines) should be able to override SMA's decision. This environmental clearance function could be institutionalized through the proposed new Ley de Medio Ambiente, or possibly through a Presidential Decree based on existing legislation. The Bank should encourage the Government to assign to SMA a practical, streamlined, official environmental clearance function for oil development projects. The Bank can promote this through its dialogue with the Government on the Oil Production Development Project and/or Environmental Institutions Project. Some conditionality regarding an SMA environmental clearance function may be appropriate for one of these two loans (especially if new legislation were not required to achieve this). In the specific case of the Oil

Production Development Project, the Bank should require SMA clearance of the Project's EA, as a condition of negotiations.

63. Besides the role of SMA (which should improve over time, with proper insitutional strengthening) and regular Bank environmental supervision missions, the Oil Production Development Project should institutionalize one other major, independent environmental monitoring mechanism. This would be an international Environmental Committee of Experts, which would function throughout the life of the loan. The Committee would provide a public "environmental audit" of Project implementation. This type of oversight would make it easier for the Bank to learn about gaps between the intentions stated on paper, and actual implementation in the field. The extra publicity provided by an international commission could also help to "shame" Petroecuador (or possibly certain IOCs) into taking environmental concerns more seriously in the course of their regular operations. The Bank is making increasing use of such independent environmental review panels in other environmentally complex (and often publicly controversial) projects, including the Brazil Carajas Iron Ore (1982) and Power Sector Management (1986), Ecuador Lower Guayas Flood Control Project (FY 90), and Bolivia Eastern Lowlands Natural Resource Management and Agricultural Production (FY 90). The use of such committees is strongly encouraged by OD 4.00.

64. The proposed Committee could be composed of one representative from SMA (which may be suitable as the Committee's official secretariat), one from the Ecuadorean NGO community (if politically acceptable to the Government), and 3-4 international environmental experts, representing specialties such as oil pollution control, protected areas management, and indigenous communities. The Committee should ideally convene three times a year in Ecuador for about 10 days per visit. During each visit, the Committee would meet with key officials of Petroecuador, other Government agencies, and IOCs; visit priority field sites to evaluate the extent of progress in addressing environmental issues; and issue a public report to Petroecuador and the Bank. The Committee's expenses (consultant fees, travel, and per diem) would be paid by Petroecuador out of the Project budget. Prior to or during loan negotiations, the Bank should agree with Petroecuador on the structure and general terms of reference of the Committee, including an acceptable list of candidates for each position. It is important for the Committee to have its first visit before Project implementation is well underway, so that "baseline" environmental conditions can be observed.

65. One other significant opportunity for environmental monitoring of the petroleum sector is Ecuador's NGO community. If Petroecuador and the IOCs were to allow routine visits to their field operations by NGO representatives, the added public scrutiny could further encourage environmental progress. There appears to be no legitimate need for oil companies to keep secret the technologies and techniques they use for oil exploration, drilling, transportation, storage, and refining. Thus, there is no obvious reason why environmental NGOs should be denied the opportunity to visit oil industry facilities (which is mostly the case today). The Bank should encourage (or possibly require, through Project conditionality) Petroecuador to allow NGO visits to its facilities,

under specified "ground rules" concerning the number and duration of visits, and other logistical details. (The NGOs could be expected to make the visits at their own expense.) Petroecuador should encourage (or require, if contract legalities permit) the IOCs to adopt similar policies regarding NGO visits.

Land Use Planning for the Amazon Region:

66. Proper management of oil industry operations is a necessary, but not sufficient, condition for ensuring environmentally sound development in Ecuador's Amazon Region. No less important are reforms in certain existing policies, particularly those involving agricultural credit and land titling. In the case of agricultural credit, the Banco Nacional de Fomento has provided subsidized credit for land clearing in areas of low agricultural potential. Particularly undesirable from an environmental standpoint is the Banco's credit for extensive cattle ranching, which provides relatively very little economic output and employment per hectare of forest cleared. In the case of land titling, the Ley de Colonizacion y Tierras Baldias and the policies of IERAC provide powerful incentives to clear forest land; deforestation is presently a virtual prerequisite for colonists to obtain titles. Because colonists can sell their land titles to land speculators and cattle ranchers (and then move on to clear more forest and obtain another title), a "land rights industry" has developed in Ecuador's Amazon Region. Possible long-term reforms in land titling laws and policies could include:

a. Deforestation should be neither a necessary, nor a sufficient, condition for obtaining land titles. Depending on land use capability, the provision of titles could even require the maintenance of a sufficient area of natural forest;

b. Land titles could be restricted, such that they could never be sold; this would help to reduce deforestation for land speculation;

c. Private land titles could only be given in those (relatively few) areas of higher-quality agricultural land. Communal, cooperative, or corporate titles (or long-term concessions) could be provided for forest-based activities, including logging and extraction of non-timber forest products; and

d. IERAC now typically provides colonists with titles to plots of 50 ha (250 meters by 2 km) or even larger. If plot sizes were significantly reduced (to about 10 ha per family), more colonists could be accommodated per land area settled, very extensive (non-forest) activities such as cattle ranching would be discouraged in favor of more intensive production systems (including naranjilla, coffee, and other tree and shrub crops), and public services would be easier to provide (because of higher-density settlements). (Larger plot sizes should be used for forest-based activities, including traditional indigenous production systems.)

67. The broader issues of Amazonian land use policies and trends are discussed in the Bank's Ecuador Environmental Issues Paper, and in the

detailed study, Ecuador: Development Issues and Options for the Amazon Region (1989, Report No. IDP-0054). To encourage Government follow-up to the latter report, the Bank plans to support a workshop of about 3 days on Ecuadorean Amazon development policies and options, to take place around mid-1990 in Lago Agrio or another Amazonian location. This forum could provide a valuable opportunity for the Bank to focus attention on Amazonian land use policy and planning issues, particularly those which are beyond the scope of the oil industry. The Bank should assist, as needed, Ecuador's Environmental Subsecretariat (SMA) with workshop planning, implementation, and follow-up.

68. One promising initiative in this regard is the development of a "Plan Regional de Desarrollo Sostenido" for the Amazon Region by CONADE, Ecuador's National Development Planning Council. The Plan is expected to designate appropriate land uses for particular areas, along with specific reforms in IERAC's land titling policies. CONADE has just begun work on the Plan, and expects to complete work in about 18 months. CONADE is still seeking additional financial and technical assistance for developing the Plan. There may be useful opportunities for Bank collaboration in this regard, possibly as follow-up to the above-described workshop. Coordination with the Inter-American Development Bank (IDB) is important, since IDB has reportedly been considering assistance to CONADE for development of this Plan.

Recommendations for Bank Follow-up:

69. Based on the findings of my mission, the following should be considered as possible conditions of the Oil Production Development Project. (Most of these were discussed with Petroecuador staff and other government officials during the mission, and appear institutionally and politically feasible.)

a. As a condition of appraisal (possibly around March 1991), Petroecuador would submit to the Bank a complete draft Environmental Assessment (EA). The EA must be revised to meet all of the Bank's environmental requirements, prior to the end of appraisal (Paras. 24-32; Annex 2).

b. As a condition of appraisal, Petroecuador would adopt an official Environmental Manual of Operations for all oil development activities with environmental implications (Paras. 16-18, 21; Annex 1). This Manual must be acceptable to the Bank, and should be reviewed by interested IOCs, NGOs, and other Ecuadorean specialists (as well as SMA) prior to Petroecuador's formal adoption of the final version. Petroecuador and all of its subsidiaries and contractors would be required to follow the Manual; close compliance with the Manual should be a condition of tranching disbursements during Project implementation. Petroecuador should also require (or, if there are legal complications with old contracts, strongly encourage) full compliance with the Manual by all international oil companies (IOCs) operating in Ecuador.

c. As a condition of appraisal (or, at the latest, loan effectiveness), Petroecuador would undertake implementation of an

adequately-financed Oil Spill Contingency Plan (drafted by ESEN-AMBIENTEC, and revised as needed to be acceptable to the Bank) (Paras. 19, 21). Continued progress in implementing the Contingency Plan should be a condition of tranching disbursements.

d. As a condition of appraisal, Petroecuador would create a Protected Areas Fund for the recurrent costs of properly managing those Ecuadorean protected areas which are affected by oil industry activities. Effective operation of this Fund would be a condition of disbursement (Paras. 47-51).

e. As a condition of appraisal, Petroecuador would submit to the Bank an approved plan for adequate staffing of the Environmental Unit (Paras. 52-53; 56). These staff should be hired and functioning as a condition of loan disbursement.

f. As a condition of appraisal, Petroecuador would show significant environmental improvements in its operating practices within the Cuyabeno Wildlife Reserve (Paras. 37-39a).

g. As a condition of loan effectiveness, the Instituto Ecuatoriano de Reforma Agraria y Colonizacion (IERAC) would officially agree not to provide land titles or otherwise encourage colonization within the Project area, except in specific areas which are documented to be environmentally suitable for agricultural settlement. If this strong condition proves to be politically unacceptable to the Government, IERAC should at least agree not to provide any land titles or other services to colonists within designated Parques Nacionales or equivalent reserves, Bosques Protectores, or indigenous territories. IERAC should also publicize its policy of not providing land titles to new colonists within specified oil development areas, through announcements in the news media and special seminars and meetings in Quito, Lago Agrio, Coca, and other municipalities; these activities could be financed through a convenio with Petroecuador.

h. As a condition of loan effectiveness, the Ministerio de Agricultura y Ganaderia (MAG) would approve and finalize the proposed expansion of the Cuyabeno Wildlife Reserve by about 150,000 ha to the east (Paras. 36, 38).

i. A possible condition of either the Oil Production Development Project or the Environmental Institutions Project (FY91) could be for SMA to have an official environmental clearance function for new oil development infrastructure (Paras. 59-62). In any case, the Bank should require SMA clearance of the EA of the Oil Production Development Project, as a condition of negotiations.

j. Conditionality could be used (if needed) to encourage Petroecuador to set up a procedure to let Ecuadorean environmental NGO representatives visit its field operations (Para. 65).

70. The following environmental components should be specifically financed under the Oil Production Development Project:

a. A 5-year environmental training program for Petroecuador staff. Petroecuador should outline a tentative training program prior to appraisal. Certain training activities should ideally begin before loan effectiveness, and could be financed retroactively under the Project, or with undisbursed funds from Loan No. 2803 (Paras. 54-56).

b. Investments to secure adequate protection and environmental rehabilitation for the Cuyabeno Wildlife Reserve (Paras. 35-39, 57). Because my mission was unable to visit Cuyabeno (due to logistical constraints), the next environmental mission related to the proposed Project should include a visit to the Reserve, to assess its needs in more detail.

c. An international Environmental Committee of Experts, which would conduct independent "environmental audits" of Project implementation about 3 times per year, for the life of the Project (Paras. 63-64).

d. Investments necessary for proper protection of Yasuni National Park, to the extent they are not provided through other sources (Paras. 40-46). The Bank should monitor the status of protection for Yasuni as CONOCO road construction proceeds in 1990. If deficiencies occur in financing necessary Park investments, the Bank's loan should include a component for financing these investments, through an agreement between Petroecuador, DINAF, and possibly Fundacion Natura.

e. Any additional environmental protection or mitigation measures identified in the EA (Paras. 24-32; Annex 2).

71. The Bank should send a detailed letter or other communication to the Executive President of Petroecuador, outlining:

a. The specific Project components that the Bank would be willing to finance (Paras. 25, 70);

b. The proposed timing of project preparation, appraisal, and implementation;

c. Terms of reference for the EA (an approved version of Annex 2, attached to the letter) which the Bank will require prior to appraisal;

d. The environment-related loan conditions that the Bank expects will be required (Para. 69); and

e. Recommending that Petroecuador initiate the EA process in earnest, working closely with the ESEN-AMBIENTEC team to select and compile the necessary technical information (Para. 32).

72. The Bank should send a detailed letter or other communication to the Minister of Agriculture, Director of DINAF, and the Chief of National Parks (with copies to Petroecuador officials), requesting that DINAF prepare a proposal for investments needed to ensure proper on-the-ground management of the Cuyabeno Wildlife Reserve. This proposal should distinguish between the most immediately needed investments

(which Petroecuador should ideally finance before loan effectiveness) and longer-term priorities (which would be regularly financed under the new loan) (Paras. 38-39).

73. The Bank should send a letter to the ESEN-AMBIENTEC Project Chief (with copies to the Environment Subsecretariat and appropriate Petroecuador officials), requesting that ESEN-AMBIENTEC send the Bank a brief written report on the study's progress, prior to each of the remaining 3 ESEN-AMBIENTEC seminars (Para. 22). The letter should include a revised, approved version of Annex 1, noting that these are the Bank's recommendations regarding specific environmental issues that should be addressed in the new Environmental Manual (Para. 17).

74. The Bank should collaborate with the Environmental Subsecretariat (SMA) in the planning and implementation of the proposed workshop on Amazonian land use policies, and pursue appropriate follow-up measures (Paras. 66-68). The Bank should also send a letter to the Environmental Subsecretary (with copies to the Director General of Environment and the Project Chief of ESEN-AMBIENTEC) encouraging closer collaboration between SMA (particularly the Direccion Nacional de Medio Ambiente) and ESEN-AMBIENTEC (Para. 23).

75. The Bank should continue to supervise closely the progress made by the ESEN-AMBIENTEC study group. Bank staff on mission should try to participate in the remaining 3 ESEN-AMBIENTEC workshops, tentatively scheduled for mid-May, July, and late October 1990. After the Environmental Manual, Oil Spill Contingency Plan, and other components of the Environmental Management Plan are drafted, the Bank should review them carefully, to ensure their adequacy and feasibility (Paras. 21-22.)

76. The new loan will also require an adequate indigenous peoples component, including probably some conditionality regarding the titling of indigenous lands within the area of influence of the proposed Project. Under Ecuadorean law, indigenous communities are not legally able to prevent oil development on their lands, because all petroleum reserves belong to the Government. However, secure land titles would better enable indigenous groups to prevent colonization, and to obtain greater benefits from whatever oil development does take place. The provision of (usually communal) land titles to indigenous peoples in Ecuador is done by IERAC, the same agency in charge of providing private land titles to colonists. Mr. Davis (LATEN) will pursue this issue further.

Cleared with and cc: Mr. Goodland (LATEN)

cc: Messrs./Mmes. Rowat (LA4DR); Bery, Augusto (LA4CO); Khoury-Haddad, Sierra, Stoddard, Gray (LA4IE); Wessels (LATDR); Davis, Koch-Weser, Plaza (LATEN); Moscote, Khelil (LATIE); Pimenta-Neves (LACVP); Walton (ASTEN); Sugar (LOALE); Collell, Carvalho (LEGLA)

ANNEX 1--RECOMMENDATIONS FOR THE NEW ENVIRONMENTAL MANUAL OF OPERATIONS
FOR ECUADOR'S PETROLEUM SECTOR:

This new Manual would apply to the operations of Petroecuador (including all of its subsidiaries and contractors) and to all IOCs operating in Ecuador. A draft of the Manual is presently being prepared by Petroecuador's consulting group, ESEN-AMBIENTEC. The following is an incomplete list of environmental issues which the new Manual should address:

1. To minimize the kilometers of roads needed, new production drilling operations should construct cluster drilling platforms (rather than dispersed individual wells) in all forested areas.
2. Road construction standards for minimizing environmental damage should be specified, including:
 - a. The layout of any new roads through forested areas should be carefully planned, to minimize their length. In some cases, the supplemental use of rivers for transporting supplies can reduce the kilometers of road built.
 - b. Maximum widths for various types of oil industry roads should be specified. In some cases, forest canopy cover can be maintained (in flat terrain), so that the road need not be a barrier to the movements of monkeys and other arboreal wildlife.
 - c. For clearing the road right-of-way, trees should be felled with chainsaws, rather than bulldozers (which cause a "domino effect" of falling trees).
 - d. The Manual should specify under which conditions gravel, heavy oil, or other materials should be used for road surfacing. (When oil is used for road surfacing, some washes away into streams; however, gravel mining disturbs river ecosystems.)
 - e. Geotextiles or "geo-plastics" (woven polyvinyl chloride or polypropylene) should be used as road construction support material (as CONOCO plans to do in Block 16), because they reduce the requirements for timber and gravel. To the extent that any timber is used for the road base, it should come entirely (or as much as possible) from trees that are cut for the road right-of-way.
 - f. Roads constructed across streams need to provide for proper drainage, such as through the use of pipe or box culverts. This is needed to avoid partially "damming" small streams, which blocks the migration of aquatic life, kills trees and increases mosquito habitat upstream of the road, and reduces water flow downstream. The culverts or other drainage systems require routine maintenance, so that they are not clogged with debris.
 - g. When are roads constructed for exploratory drilling environmentally justified (in comparison with the environmentally more

benign alternative of using helicopters)?

h. After they are no longer needed (such as after exploratory drilling) roads built through forested areas should be decommissioned (such as by removing the bridges) to reduce future colonization risks.

3. Prior to building new roads are through forested areas with special legal protection (such as Parques Nacionales, Bosques Protectores, or indigenous reserves), Petroecuador (or the relevant IOC) should financially support a 24-hour roadblock and a regular system of patrols to prevent illegal colonization. This can be done through convenios with DINAF, and (as needed) the Army and IERAC. Locating the oil workers' camp just outside the entrance to the protected area can also help deter colonization. Properly staffed roadblocks can also be used to control the transportation of illegally cut logs, wildlife products, or other contraband from the forest.
4. Petroecuador should avoid using its Fondo de Desarrollo Comunal (Community Development Fund, used to finance small-scale development projects in areas near Petroecuador facilities) for building or improving roads through forested or legally protected areas. Rural roads financed through Petroecuador's Fondo de Desarrollo Comunal (or similar "community relations" funds which some IOCs have) should be subject to the same environmental criteria as roads planned for oil production purposes.
5. Any formation water produced from drilling operations should be reinjected into the ground. In any cases where this might not be feasible, the produced water that is not recycled (e.g. to formulate new drilling muds) should be treated on-site (using aeration spraying or cascading for oxygenation and cooling, skimming of surface oil, flocculation and settling to remove certain salts, dilution with fresh water, etc.) prior to being discharged in adjacent waterways. The same treatments (as needed) should be used for water piped out of oil sumps.
6. Spent drilling muds should be landfilled in dry pits or sumps (from which the water has been piped out). The pits should be lined (e.g., with plastic) to minimize risks of groundwater contamination. The landfilling should take place before the site is abandoned, while on-site bulldozers are still available.
7. While they are in use (prior to eventual landfilling), oil sumps (ponds, pits, piscinas) should be screened from above with 1" (or finer) mesh nets, to prevent birds, mammals, and larger insects from entering the sump and being trapped and killed by the surface oil. These nets (legally required in parts of the United States) cost about US\$100 each, which is insignificant relative to the costs of drilling each well.
8. All infrastructure which holds petroleum or its derivatives (pipelines, storage tanks, refineries, etc.) should have a precise schedule of routine maintenance, including periodic replacement of parts, to minimize risks of spills or other malfunctions due to poor maintenance.

9. Design standards are needed for any new pipelines to transport petroleum, its derivatives, or natural gas. These should indicate:
 - a. The extent to which pipelines (and the adjacent service roads) should be re-routed around environmentally sensitive areas, particularly National Parks and equivalent reserves. (The mission was told that a new Petroecuador pipeline near the coast south of Manta may threaten the Machalilla National Park.)
 - b. Under which circumstances pipelines should be buried for environmental reasons (such as to reduce forest clearing for the right-of-way, or to reduce risks of damage from vehicle crashes along highways); and
 - c. Proper spacing and types of valves and automatic shut-off mechanisms, in case of leaks.
10. Oil storage tanks need permanent earthen levees around them; the levees should be able to contain all of the oil from the storage tanks, in case the latter should rupture.
11. Refineries and gas plants need appropriate water pollution control equipment, proper operational and maintenance procedures for this equipment, and staff who know how to operate and maintain the equipment.
12. New camps built in forested areas should not use more land than is required for buildings, recreational purposes, and safety considerations. (As an example of what to avoid, the Texaco camp in Lago Agrio occupies many more hectares of once-forested land than necessary, due to huge lawns and overly wide streets.)
13. After drilling or other operations which involve land clearing or excavation are terminated, the cleared land should be rehabilitated. (In humid tropical zones such as Amazonia, simply spreading out the soil which was originally scraped off during site preparation will generally promote rapid natural revegetation, so that manual reforestation or other intensive landscaping are usually not needed.)
14. Spent motor oil and similar wastes should be collected in barrels and burned or landfilled--not discharged into streams and rivers. No washing of motor vehicles in streams and rivers should be allowed.
15. All fishing (especially with dynamite or poisons) and hunting by oil workers should be strictly prohibited; oil companies and contractors must therefore transport sufficient quantities of food to their workers.
16. No firearms should be allowed in remote, forested oil exploration or production areas. In Ecuador, where guerilla groups are absent, firearms are not needed for "protection". (The mission received undocumented, but plausible, reports that heavily-armed security guards for Petrobras in Block 17 shoot at Waorani Indians when they get a chance.) If some legitimate need for firearms were to develop, only pistols should be allowed, because they are less effective than rifles or shotguns for hunting.

17. Mobility restrictions are needed for oil workers in forested or other sensitive areas. For example, oil workers should not be allowed to stray from camp in areas near indigenous populations. Also, no alcohol should be permitted in such areas.
18. All non-biodegradable solid wastes (such as plastics) should be deposited in small, on-site landfills. "Littering" with any such wastes should be prohibited.
19. Adequate operational safety standards and procedures (consistent with the Bank's Occupational Health and Safety Guidelines) should be implemented.
20. Contracting documents (for contractors) and bidding documents (for IOCs) should explicitly outline all environmental protection measures that would be required (those specified in the Manual, and any others that may be warranted for special cases). Sufficiently large financial penalties should be specified for all violations of this Manual by contractors and IOCs.
21. A transparent system of penalties (fines, suspension, or termination) should be established for individual employees (of oil companies or contractors), for each type of violation of the Manual.
22. The number, specific duties, and necessary qualifications of on-site (field) environmental control officers should be specified for each type of oil development activity, along with the approximate budget allocations needed to support these staff in the field. Besides operational activities, some staff should be responsible for routine, on-site environmental monitoring (of water quality, aquatic life, etc.).
23. The legal framework (laws, regulations, administrative decrees, etc.) underlying this Manual should be specifically indicated. This Manual should be a public document; copies should be readily available to any interested Ecuadorean NGO or member of the public.

ANNEX 2--DRAFT TERMS OF REFERENCE FOR ENVIRONMENTAL ASSESSMENT OF THE
PROPOSED OIL PRODUCTION DEVELOPMENT PROJECT:

1. Prior to World Bank appraisal (around March 1, 1990 [OR INSERT ALTERNATE EXPECTED DATE]) of the Oil Production Development Project, Petroecuador must complete an Environmental Assessment (EA) of the Project. Petroecuador should carry out the EA by using in-house Environmental Unit staff, taking full advantage of the large body of technical information being developed by the ESEN-AMBIENTEC study. Petroecuador should begin work on the EA as soon as possible, to make use of the expertise provided by the ESEN-AMBIENTEC group (which is scheduled to complete work around November 1990). Petroecuador should consider hiring any additional, short-term consultants for the EA only to the extent that certain necessary tasks could not be done by in-house staff (with technical backup from ESEN-AMBIENTEC staff).
2. To satisfy the Bank's requirements, the EA report should contain all of the features listed below. These are elaborated in the Bank's Operational Directive on Environmental Assessment [SHOULD BE ATTACHED]. The EA report's recommendations must also be fully consistent with all of the Bank's relevant environmental policies (Wildlands, International Waterways, Emergency Recovery Assistance, Cultural Properties, Tribal Peoples, and Involuntary Resettlement) and guidelines (Oil and Gas Development-Onshore, Oil and Gas Pipelines, Hazardous and Toxic Materials, Industrial Hazards, and Occupational Health and Safety). [COPIES OF ALL THESE POLICY STATEMENTS AND GUIDELINES SHOULD BE SENT TO PETROECUADOR, ALONG WITH THESE TERMS OF REFERENCE.]
3. The EA report should contain:
 - a. An Executive Summary;
 - b. A discussion of the legal, policy, and administrative framework within which the EA is prepared. This would include a brief discussion of all relevant Ecuadorean environment-related laws and regulations, as well as the World Bank's environmental policies and guidelines;
 - c. A detailed description of all proposed Project components, including the precise geographical locations and timing of construction for all Project-related infrastructure (whether financed under this Project or separately), and the broader area of influence of the project's environmental impacts;
 - d. Baseline environmental data on relevant biological, physical, and socio-economic features of the project's area of influence. These include:
 1. Major environmentally sensitive areas, including different types of forests; wetlands; rivers, streams, and lakes; all legally protected areas (including Parques Nacionales and equivalent reserves, and Bosques Protectores); centers of exceptional species

diversity and endemism; and other wildlands;

ii. Wild animal and plant species which are known to be threatened with extinction, of major local economic importance, or particularly vulnerable to Project activities;

iii. Existing and projected (even without the Project) future land uses, how they compare with the existing natural resource base (including soils and agricultural land use capabilities), and the extent to which these land uses are legal, or in accordance with official Government plans for the area.

iv. Geology and topography, particularly any risks from earthquakes, landslides, or other disturbances;

v. Surface and groundwater hydrology, including rainfall and flooding patterns;

vi. Information on human communities, including ethnic background (types of indigenous groups and colonists), population size and projected growth, principal economic production systems (such as different types of agriculture, hunting and gathering, trading and services, and oil industry labor), employment, income distribution, access to public services, public health problems, and any major social tensions or conflicts;

vii. Cultural properties, including archaeological, historic, and sacred religious sites; and

viii. Ongoing and proposed development activities with significant environmental effects (but not directly related to the proposed Project);

e. All significant environmental impacts (direct and indirect, short- and long-term) likely to result from the proposed Project should be identified and (to the maximum extent possible) quantified. Annex A2 of the Bank's Operational Directive provides a checklist of categories of possible environmental impacts. The EA report should indicate specifically how the environmental features described in the above paragraph would change under the project.

f. Analysis of alternatives in project design (including siting and technologies used) and operation, to minimize negative environmental impacts. Each alternative should be evaluated in terms of its environmental impact, investment and recurrent costs, and institutional, training, and monitoring requirements. The least environmentally damaging alternatives must be selected and incorporated within project design, unless there are compelling reasons not to do so (for example, if the financial costs were to be prohibitive). Any departure from recommending the least environmentally damaging alternatives must be explicitly justified. Project design must also comply with the all of the guidelines set forth in the Environmental Manual of Operations, which Petroecuador would officially put into effect as a condition of Project appraisal. (A preliminary draft of this Manual is presently

being prepared by the ESEN-AMBIENTEC group.);

g. A Project-specific Environmental Management Plan, which would outline in detail all measures needed to minimize, mitigate, or compensate for any expected environmental damage from the Project. This Plan should include a precise division of institutional responsibilities for its implementation (including proper monitoring of compliance and of environmental quality) within Petroecuador and its affiliates, and including any necessary convenios with DINAF, IERAC, or other national and local Government agencies. The Plan should also contain a timetable of planned activities (which must be properly synchronized with Project construction plans) and budget (which would include a discussion of how the Plan would be fully financed). The Plan should also indicate the numbers and qualifications of environmental staff required, within Petroecuador and its affiliates, for proper Plan implementation. Note that this Project-specific Plan is administratively different from the "Plan de Accion Ambiental" presently being developed by ESEN-AMBIENTEC (which is broader in scope, and not specific to the particular infrastructure proposed for financing under the Oil Production Development Project); and

h. Summaries of comments provided by Government and non-Governmental organizations on the draft EA and the proposed Project itself (see below), and a brief discussion of how these comments were incorporated within the final EA. The final EA should also mention those comments which were rejected as inadvisable, and specifically indicate why those comments were rejected.

i. Important supplementary information, including a bibliography of references (published and unpublished), maps, aerial or ground photographs, technical diagrams, etc.

4. Petroecuador should review and expand, as needed, these draft terms of reference. Within two months of beginning work on the EA, Petroecuador should organize two formal meetings to obtain constructive suggestions for carrying out the EA, and for improving the design and implementation of the Project's environmental components. One of these meetings should be with all interested Government agencies, including the Subsecretaria de Medio Ambiente (SMA), Direccion Nacional Forestal (DINAF), Instituto Ecuatoriano de Reforma Agraria y Colonizacion (IERAC), and Consejo Nacional del Desarrollo (CONADE), among others. The other should be with interested non-Governmental parties, which should include environmental NGOs, including Fundacion Natura, Corporacion de Defensa de la Vida (CORDAVI), Natural Resources Defense Council, Tierra Viva, and others; indigenous peoples' NGOs, such as the Confederacion de Nacionalidades Indigenas de la Amazonia Ecuatoriana (CONFENIAE); all international oil companies and contractors with existing (or formally planned) operations in Ecuador; independent experts, such as consultants and university professors; and any other interested members of the public. Representatives of ESEN-AMBIENTEC should be present at both meetings. The written invitations for both meetings should include a copy of the terms of reference (and draft table of contents, if available) for the EA, a brief description of the proposed Project (which can be provided by the World Bank), a small-

scale map of the main Project areas, a chronogram of the planned EA preparation, and a copy of the Spanish version of the Bank's EA Operational Directive.

5. At about the half-way point of EA report preparation (around October 1990), Petroecuador should conduct a 1-day public briefing for all of the Governmental and non-Governmental entities mentioned above. This briefing would be an orally presented "mid-term report" on progress with the EA study, as well as preliminary findings and recommendations. Petroecuador should solicit additional constructive comments on EA content or Project design from participants in this meeting.
6. After a draft EA is completed, it should be formally reviewed and approved by SMA (as would ideally be the case with all new Petroecuador projects); the Bank will carefully consider SMA's comments before completing its appraisal of the proposed Project. Copies of the draft EA should also be sent to the same Governmental and non-Governmental representatives who participated in the earlier two meetings (discussed in the above paragraph); these representatives should be invited to provide comments on the draft EA. These comments can be in writing, or presented orally at one of two additional formal meetings (one for Governmental and one for non-Governmental representatives), which Petroecuador should specifically convene to review the findings and recommendations of the draft EA. Petroecuador should take all constructive comments into account in finalizing the draft EA.
7. During the process of preparing the EA, Petroecuador should send brief (about 5 pages) bi-monthly progress reports to the World Bank. These reports should indicate:
 - a. Which major tasks have been accomplished, and which remain to be done;
 - b. The pace of progress in completing the EA, and whether any delays are expected;
 - c. Any surprising findings which could substantially change Project design or implementation plans; and
 - d. Any unforeseen problems which the Bank could help resolve.
8. The EA report should be no longer than is necessary to convey all of the information needed for proper environmental evaluation and design of the Project. Most of this information is outlined above. Making the EA report exceptionally long will not make it more useful.
9. Following Bank appraisal of the proposed Project, the final EA should be made available to interested members of the public (free or at a nominal charge, if needed to cover reproduction costs).

ANNEX 3--LIST OF OFFICIALS MET:

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Consejo Nacional del Desarrollo (CONADE):

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CONOCO Ecuador Ltda.:

Alex B. Chapman, Manager, Environmental Protection Project

Edward J. Davies, President and General Manager

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H.J. van Wageningen, Counsel, Legal Department

Corporacion de Defensa de la Vida (CORDAVI):

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Dr. Byron Real Lopez, Presidente

Direccion Nacional Forestal (DINAF):

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Ing. Leonel Rojas B.

Ing. Luis Valdivieso, Petroleum Engineer

Fundacion Natura:

Maria Fernanda Espinosa (works on Amazonian protected areas)

Instituto Ecuatoriano de Reforma Agraria y Colonizacion (IERAC):

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Dr. Luis Luna Gaibor, Director Ejecutivo

Ministerio de Energia y Minas:

Carlos Luzuriaga, Subsecretario de Medio Ambiente

Ing. Nelson Suquilanda D., Director General de Medio Ambiente

Natural Resources Defense Council:

Judith Kimerling, Latin America Representative

Petro-Canada Oil and Gas, Inc.:

Michael MacIntyre, Gerente Residente

Petroecuador:

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Ing. Ivan Bedoya O., Subgerente de Contratacion Petrolera

Carmen Davalos, Unidad de Proteccion Ambiental

Dr. Angel Jijon A., Especialista, Jefe-2

Jose Narvaes, Jefe, Shushufindi Refinery

Ing. Luis Roman Laso, Presidente Ejecutivo

Lic. Manuel Navarro V., Jefe, Unidad de Proteccion Ambiental

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Texaco Petroleum Co.:

Econ. Eduardo Borja M., Supervisor de Presupuesto

Tierra Viva, Quito:

Virgilio Benavides, President

Marcia Valarezo, Environmental Coordinator

United States Agency for International Development (USAID):

Dr. Fernando Ortiz-Crespo, Environmental Specialist

OFFICE MEMORANDUM

~~CONFIDENTIAL~~

DATE: January 11, 1993

TO: Dennis Mahar

FROM: George Ledec *GL*

EXTENSION: 39267

SUBJECT: Environment-related Policy Agenda Items
- Suggested "Talking Points"

DETERMINED TO BE AN ADMINISTRATIVE

MARKING INITIALS: MAY DATE: 3/13/2017

1. Per your request, this memo provides a few possible "talking points" for Mr. Husain's upcoming Board discussion regarding major items on the policy agenda involving "green" (ecology-related or rural) environmental issues.

Summary of Major Problems:

2. Overview. The principal "green" environmental problems in the LAC Region include deforestation, land degradation, loss of biodiversity, improper use of water resources, and mismanagement of fisheries. Many of these problems are related to the new settlement of environmentally sensitive frontier areas; others are the result of natural resource mismanagement in long-settled regions. Although considerable progress has been made on some fronts, environmental conditions continue to deteriorate in most LAC countries. The situation is especially critical because some environmental damage is irreversible--for example, animal or plant species which become extinct can never be resurrected.

3. Settlement of Frontier Areas. Despite high rates of urbanization, many LAC countries are still experiencing substantial new human settlement of forested frontier areas. These frontier areas are undergoing rapid deforestation, which typically results in land uses (such as extensive cattle pasture) which generate little long-term employment and are often unsustainable. Frontier settlement also often exacerbates rural public health problems (such as malaria), as well as social conflicts (especially between settlers and indigenous people) over land use rights.

4. Natural Resource Degradation in Settled Regions. Although it is characteristic of deforested frontier areas, land degradation (such as soil erosion, compaction, and fertility decline) is also a major problem in established agricultural areas. In particular, improper agricultural techniques and deforestation on steep slopes often increase soil erosion, flood damage, and the sedimentation of hydroelectric and water supply reservoirs and inland navigation systems. Coastal erosion, a major economic problem most

evident during storms, is exacerbated by human activities such as wetland elimination, building too close to beaches, and sand mining. The misuse of irrigation water often produces the salinization and waterlogging of soils, as well as the depletion or contamination of surface and groundwater. Excessive and improper use of agrochemicals results in significant water pollution, poisoning of farm workers, and fish and wildlife losses, along with causing some export crops to be rejected on international markets. Many freshwater and coastal fisheries are being damaged by overfishing, incidental take, and loss of habitat (due to degradation of coral reefs, elimination of mangroves and other wetlands, and pollution from many sources).

Recommended General Policy Reforms:

5. Strengthen Institutional Frameworks. LAC governments need to strengthen their capabilities for environmental management and regulation. This need is highlighted by the current trend for privatization of many industries (including electric power, mining, and natural resource harvesting). Many LAC countries still require adequate environmental legislation and implementive regulations. Even those countries with adequate legal frameworks need to strengthen enforcement efforts and ensure that penalties for non-compliance are adequate. In many cases, the institutional responsibilities for environmental management must be more clearly defined, to avoid overlapping or conflicting mandates. Lack of skilled human resources is still a major constraint for designing and implementing environmental programs in virtually all LAC countries. Substantial environmental training is needed, along with adequate compensation to ensure that enough newly-trained staff remain in key government positions. All this institutional strengthening needs to take place within a general context of government downsizing. LAC governments must therefore be more realistic and strategic in their environmental management activities, relying more on cooperative agreements with NGOs and local governments.

6. Institutionalize Environmental Assessment. The 1992 World Development Report makes the case that environmental assessment (EA) of projects can have a very high economic rate of return, by preventing costly mistakes in project design. EA work needs to be thoroughly internalized within member government agencies, so that they do it routinely, not only when required for Bank-financed projects. Some of the Bank's sector investment loans provide an opportunity to do this, such as when an EA screening mechanism set up specifically for Bank-financed sub-projects is then used for all the sub-projects approved or implemented by a particular agency.

7. Improve Pricing Policies. Since a substantial amount of environmental degradation is attributable to the under-pricing of natural

resources or major inputs, continued progress is needed in adjusting the prices of such items as fuel, agrochemicals, water, and electric power.

8. Improve Employment Opportunities Away From Fragile Areas. Much of the deforestation and other natural resource degradation in LAC countries (especially in frontier areas) is carried out by rural people who lack more attractive employment opportunities. Thus, any policies which promote increased employment away from frontier or other ecologically sensitive rural areas can reduce the pressure on those areas. Such alternative employment opportunities should be created in those settled rural areas where intensification of agricultural production and processing can be sustained, as well as in urban areas. The provision of improved housing, water supply, health, education, and other services in urban or non-frontier rural areas can also help to divert migration away from the more environmentally sensitive areas.

Recommended Policy Reforms in Specific Sectors:

9. Agriculture. Agricultural policies in LAC countries should generally emphasize the sustainable intensification of production on existing agricultural lands, rather than expansion onto new, forested lands. In this context, many LAC governments still need to modify land titling and agrarian laws and policies to avoid creating perverse incentives for deforestation in order to obtain titles or land use rights. At the same time, policies are needed to improve the efficiency of land markets and promote sustainable intensification in already settled areas. More rational use of irrigation water, through improved pricing and better planning of irrigation infrastructure, would help to correct problems such as salinization, waterlogging, and depletion of water supplies. The environmental problems associated with agrochemical (pesticide and fertilizer) use would be reduced by raising prices, avoiding credit subsidies, and improving regulation, enforcement, and farmer education.

10. Forestry. The logging of natural forests is often done in ways which cause substantial unnecessary forest damage and even deforestation (from uncontrolled settlement along logging roads). However, natural forest logging, if done carefully, protects the environmental values of the forest (including most biodiversity), while generating local income and employment. Policy reforms needed to make natural forest harvesting more environmentally acceptable include changing the ways by which logging concessions are awarded and renewed. It is also necessary to raise stumpage fees and otherwise improve cost recovery for sustainable forest management. In some LAC countries, forestry plantations have become an economically successful and environmentally sustainable form of wood production.

11. Biodiversity Conservation. Since the main threat to most animal and plant species in LAC (and worldwide) is the loss of natural habitats, the most important tool for biodiversity conservation is an ecologically representative network of protected areas. It is necessary to increase the coverage of those ecosystem types which are currently un- or under-represented by protected areas. Even more important is improving the on-the-ground management of existing protected areas, many of which are still only "paper parks". Improved long-term management of protected areas requires adequate financing of recurrent costs, which can (in some cases) be facilitated through improved cost recovery from park users and the use of trust funds or endowments. Many protected areas need to be managed under appropriate "multiple use" systems to accommodate the needs of local people. In some countries, the most important natural areas are located on privately-owned lands. Since land acquisition costs may be prohibitive, cooperative arrangements with private landowners are sometimes a suitable mechanism for conservation. In many cases, the management of protected areas can successfully be contracted out to NGOs. The GEF is proving to be a valuable vehicle for biodiversity conservation in LAC. Nonetheless, the conservation of biodiversity and wildlands should be incorporated more fully within the Bank's regular development work. As an example, the Bank's recently-approved loan to Venezuela for the National Parks Management Project is justified on economic grounds, because of the hydroelectric power, urban water supply, irrigation, coastal fisheries, and tourism benefits provided by the parks.

12. Infrastructure. Greater care is needed in the planning of government investments to avoid inappropriate new infrastructure in environmentally sensitive areas. For example, new roads through forested frontier areas should be built only under exceptional circumstances. Investment in road construction and improvement should be concentrated instead in well-settled rural areas, away from the forest frontier, where environmental degradation is less likely (and where a larger population is likely to benefit from the increased access to markets and services).

13. Energy. In the electric power sector, the ongoing privatization in a number of LAC countries is likely to imply fewer huge "megaprojects" in the future, since investments in new generating capacity will be subject to greater discipline from market forces. Nonetheless, governments will continue to have an essential role in the environmental regulation of the power and other energy industries. There is a need to incorporate environmental considerations into the selection of new power projects. For example, for the same amount of power generated, some hydroelectric projects in LAC inundate up to 6,000 times as much land as others, with correspondingly greater environmental damage. There is also substantial scope for increased energy demand management, both through raising prices and more aggressive promotion of energy-conserving technologies.

14. Industry and Mining. The wide variety of mining techniques used in LAC entail various environmental problems, including water pollution from tailings, sediment, and (in the case of gold mining) mercury. These problems can generally be controlled through economically viable changes in the mining technologies and practices used. However, regulatory and enforcement mechanisms need to be strengthened to control the environmental damage from mining and other industries. In the case of small-scale or artisanal mining, special efforts (such as those supported by the Bank in several countries) are needed to organize the miners to use techniques which are less environmentally damaging.

Concluding Remarks:

15. The Bank is willing to assist our Borrower countries in the LAC Region to carry out those policy reforms (such as the ones outlined above) which will promote environmentally sustainable development. The Bank is also providing environmental assistance to many LAC countries through our lending program, which includes investments in environmental institutional strengthening, environmental monitoring, and natural resource management and planning.

cc: LATEN HL Staff, Binswanger

OIL EXPLORATION IN THE TROPICS
Guidelines for Environmental Protection

IUCN
Environmental Impact Assessment Services

IUCN – The World Conservation Union
1991

IUCN – The World Conservation Union

Founded in 1948, IUCN – the World Conservation Union – is a membership organisation comprising governments, non-governmental organisations (NGOs), research institutions, and conservation agencies in 120 countries. The Union's objective is to promote and encourage the protection and sustainable utilisation of living resources.

Several thousand scientists and experts from all continents form part of a network supporting the work of its six Commissions: threatened species, protected areas, ecology, strategy and planning, environmental law, and education and communication. Its thematic programmes include forest conservation, wetlands, marine ecosystems, plants, the Sahel, Antarctica, and population and sustainable development. These activities enable IUCN and its members to develop sound policies and programmes for the conservation of biological diversity and sustainable development of natural resources.

IUCN Environmental Impact Assessment Services

IUCN provides a pre-funded EIA support service for the governments of developing countries. This includes services in various aspects of EIA initiation and implementation, including scoping, preliminary assessment, project management, communications, review, institutional development and training. The service is characterised by a rapid response, based on independent scientific advice from the knowledge and experience of specialists within the IUCN network. EIA Services are available through IUCN Headquarters in Switzerland or any of the Regional Offices listed on the back cover.

EIA Service assignments related to oil exploration have been conducted in Zimbabwe, Guatemala, Congo and Ecuador. Guidelines reflecting IUCN's experience in other development sectors will be published as an occasional series.

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The designations of geographical entities in this book, and the presentation of the material, do not imply the expression of any opinion whatsoever on the part of IUCN concerning the legal status of any country, territory, or area, or of its authorities, or concerning the delimitation of its frontiers or boundaries.

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Information on the oil exploration process (Section 2) and its terminology (Glossary) have been abstracted from 'Nature Conservation Guidelines for Onshore Oil and Gas Development' and are reproduced with the kind permission of the Nature Conservancy Council representing the UK as a state member of IUCN.

PREFACE

IUCN has produced these guidelines for the use of government agencies and other interested parties within tropical countries for which oil exploration is proposed. Readers having responsibilities in this subject may also wish to consult the 'Oil Industry Operating Guidelines for Tropical Rainforests' issued simultaneously by the Oil Industry International Exploration and Production Forum (E & P Forum), 25/28 Old Burlington Street, London, W1X 1LB, UK.

Chapter 1: INTRODUCTION

The oil industry has made a considerable impact upon the environment since its earliest days: tanker wrecks and blow-outs being the most notorious incidents. However, oil exploration itself can have effects on the environment which, while less spectacular, may be more widespread and longer-lasting.

Exploration for hydrocarbons is moving to ever more remote parts of the world. These include ecosystems which are both fragile and of great importance for wildlife conservation, such as, savannas, woodlands and tropical forests.

However, the chance of finding oil or gas may give the countries concerned their only opportunity to break out of the poverty trap that stifles human development. The environmental challenge, therefore, is to develop safeguards that will enable exploration (and subsequent production) to be undertaken without significant damage to the natural environment, and consequent effects on the people and wildlife that it supports. It is hoped that the guidelines which follow will help to meet that challenge.

The guidelines are arranged in three sections which describe:

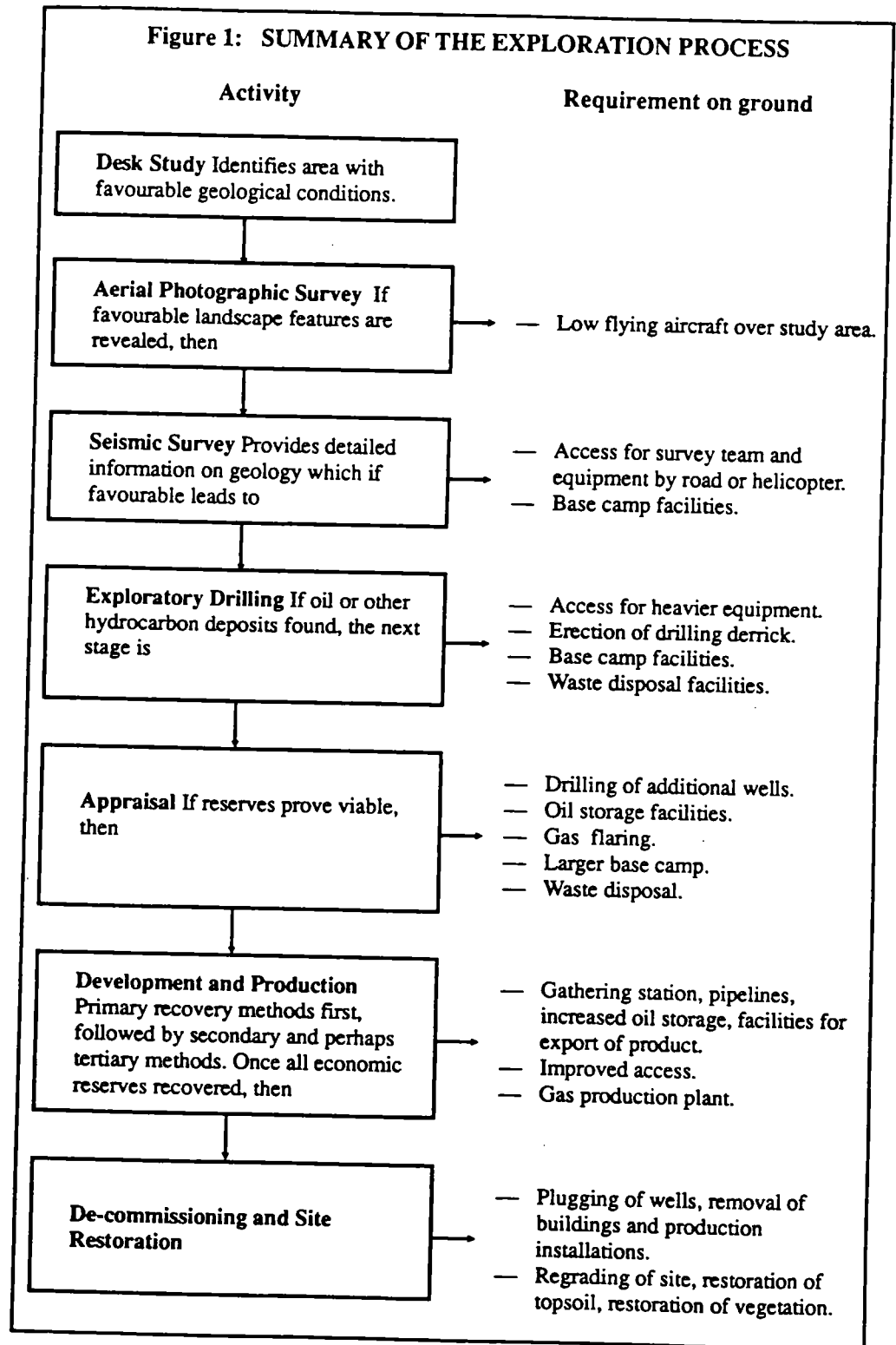
- The oil exploration process.
- The potential adverse environmental effects of this process.
- The means of environmental protection to avoid or minimise these effects.

The latter section contains a series of specific environmental protection measures which form the bulk of these guidelines. Notes are also provided on the matters of environmental management, formalisation of protection measures and their monitoring and enforcement.

The guidelines refer only to oil exploration and to exploration on land. Additional safeguards are needed for the development and production of hydrocarbons and for oil exploration in marine or lacustrine environments.

The guidelines cannot be a substitute for comprehensive environmental assessment prior to campaigns of exploration and for rigorous environmental management during exploration activity.

Figure 1: SUMMARY OF THE EXPLORATION PROCESS



Chapter 2: THE OIL EXPLORATION DEVELOPMENT AND PRODUCTION PROCESS

In order to appreciate the potential impact of oil exploration upon the environment, one must understand the activities involved. The area identified for exploration is known as a 'prospect', the exploration of which moves through a sequence of clearly defined stages, as each confirms (or rejects) the evidence of the previous stage. These exploration steps are summarised at Figure 1 and outlined below.

2.1 Identifying a Potential Hydrocarbon Reserve

In the first stage of the search for hydrocarbon-rich rock formations, geological maps are reviewed to identify major sedimentary basins. Aerial photography may then be used to identify promising landscape formations such as faults and anticlines. These are folds in geological strata which form domes or arches, sometimes trapping hydrocarbons. However, more detailed information is needed about the nature of the underlying rocks. This information is assembled using three main survey methods: magnetic, gravimetric and seismic. Of these, seismic survey is the most common and it is often the first field activity that an oil company will undertake. There are two types of seismic survey: vibroseis and shot hole.

2.1.1 Vibroseis

The vibroseis technique involves the use of a team of heavy vehicles linked together by power and communication cables. There are usually three to five large vibrator units which vibrate the ground subsonically, while a number of support vehicles record the returning shock waves for analysis. The vibrators operate for 20-30 seconds at a time and the unit is then moved on a few metres to the next vibration point. In a typical day, such a team may cover about five kilometres. Vibroseis work is generally confined to roads or other hard surfaces such as grassland areas. In wooded or bushed terrain a trace would have to be cut to provide access for the heavy vehicles.

2.1.2. Shot Hole

The shot hole method involves the detonation of small explosive charges which are placed in boreholes. The boreholes, drilled to a depth of 30 cm, are usually placed 35 m apart in straight survey lines along a specific compass bearing. Detonation produces seismic waves which are reflected to different degrees by the underlying rock strata. The returning shockwaves are recorded by very sensitive microphones, called 'geophones'. The information gathered in this way can then be used to map the underlying strata, while computer modelling can help to calculate the size and shape of any structure worthy of further investigation. The shot hole method can be conducted without the need to cut a trace: if necessary access can be provided by helicopter.

2.2 Exploratory Drilling

Once a promising geological structure has been identified, the only way to confirm the presence of hydrocarbons, and the thickness and internal pressure of any reservoir, is to drill an exploratory borehole.

In current oil industry practice, topsoil and subsoil are removed and banked separately around the edges of the site, ready for replacement once drilling is completed. The site is then levelled

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or terraced as appropriate to form a base for the drilling rig. If rigs are to be delivered by helicopter (helirigs) then an additional area must be cleared for a flyway. Drilling rigs transported by lorry will require 25-60 lorry loads (depending on size of both rig and lorry) to move the rig on to the site.

Where drilling sites are remote from existing roads and services, the construction of access routes and the provision of water, communications and power, may introduce ancillary activities beyond the boundaries of the site.

Drilling is typically carried out with a rotary drilling rig. The standard rotary rig is about 40 metres high and uses a 'drill string' made up of 12 metre lengths of steel pipe. The drill string is tipped with a drill bit, which grinds through the rock as the drill string is rotated. The rig drill string is supported by a steel framework tower, called a derrick, which sits on a drilling floor. The derrick houses the winching equipment needed to lower and raise the drill string, the rotating table used to turn the drill string, and the power unit. As the borehole gets deeper, drilling has to stop periodically to allow new lengths of pipe to be added to the string and to replace the drill bit. Steel casing is run into completed sections of a borehole and cemented into place. This casing provides structural support to maintain the integrity of the borehole, and protects underground water resources from contamination by oil or drilling fluids.

To cool the drilling bit and flush out rock fragments, water-based drilling mud is continuously circulated down the drill pipe and back up the borehole. A typical borehole 1,500 metres in depth uses between 200,000 and 500,000 litres of drilling mud.

The weight of mud in the borehole also helps to prevent blowouts by providing a counter balance to any underground pressure encountered when the bit enters gas, oil or water bearing rocks. The risk of blowouts is further reduced by the standard use of 'blowout preventers', steel rams which can close around the drill string in a matter of seconds to seal off the well. Drilling sites are also designed to contain accidental spillages, using lined drainage ditches and sumps.

In addition to the drilling rig itself, a typical site will also contain power generator sets; drilling mud tanks and mixing pumps; a shale shaker used to separate rock chippings from drilling mud; tanks for fuel, water and extracted oil; site offices and security arrangements. The whole drilling site may extend to approximately one hectare.

A base camp will also need to be established to service a group of exploratory drilling sites. This will occupy about 1000 m² and will be located close to access and delivery routes. The site will usually be surrounded by security fencing. The base camp should be self-contained and provide workforce accommodation, canteen facilities, radio room, water wells, vehicle maintenance and parking area, helipad, bunded areas for the storage and handling of fuels, provision for the collection, treatment and disposal of sewage effluent and for the collection and incineration of refuse.

Drilling operations are a round-the-clock activity. The time taken to drill a borehole depends on the depth of the oil-bearing formation and the geological conditions encountered, but it is commonly in the order of one to two months. Where oil is found, initial tests are carried out to establish flow rates. Any gas produced as a result is vented to the atmosphere or flared (burned off), while any oil is stored in tanks and subsequently may be burnt on site in burn pits.

After one to three months of drilling and initial testing, the rig is dismantled and moved to the next site. If the exploratory drilling has been successful, a small, 1.2 metre well-head valve

known as a 'christmas tree' is installed. If the well proves dry, the well is plugged with cement, all site equipment is removed, and the site is reinstated (see 2.5 below).

2.3 Appraisal

The appraisal stage aims to evaluate the size and nature of the reservoir, to determine the number of wells required to extract the hydrocarbons and to establish the probable production profile over the expected life of the field.

The consistency of oil varies considerably, from heavy viscous fluid to light, free-flowing liquid. The nature of the oil and the geological structure within which it is found, determine the number of wells needed to drain the reservoir. Further seismic work and the drilling of additional wells may be needed to establish the size of the reservoir. The operator may opt for 'deviated drilling', which involves drilling at an angle from a site adjacent to the original discovery borehole. If it is thought to be a more significant find, a 'step-out' option will often be pursued, with several new boreholes being drilled at a distance from the original borehole.

During appraisal, the reservoir is tested to see whether the oil will flow under the natural pressure within the reservoir or whether pumping will be needed to bring it to the surface. If pumping is required, a simple pumping mechanism popularly known as a 'nodding donkey', standing four to six metres in height, will be installed to determine the likely flow rate and other characteristics of the reservoir. The oil is stored on site and then removed by road tanker, involving perhaps one or two trips a day.

Associated gas produced during appraisal may be burned off where it is present in small quantities.

2.4 Development and Production

If the field is viable, the reservoir may be small enough to be tapped using one or more of the existing exploratory or appraisal wells. If so, the production stage will result in little extra drilling activity. On the other hand, the reservoir may need to be tapped by additional production wells. The use of deviated drilling can allow more than one production well on a given site. Where two or more well sites tap a reservoir, a gathering station may be needed to provide a central facility for preparing the hydrocarbons and wastes for export from the area. The size of the installations needed for separating oil, water and other wastes depends on the nature of the reservoir and the export option selected.

Any significant quantities of gas produced are treated to produce commercial gas or pumped back into the reservoir to maintain its internal pressure. Smaller quantities of gas are vented or flared. Any water extracted with the oil or gas is treated for disposal or reinjected into the reservoir. Reinjection wells are often bored specifically for this purpose. Where reservoir pressures are particularly low, additional quantities of water may need to be imported to the site requiring pumping stations and water pipelines.

Many oilfields involve a simple production system of nodding donkeys to pump the oil to the surface; facilities to separate oil, gas and water; and road tankers to transport the products off site. Whereas the electrically driven nodding donkeys tend to be relatively inconspicuous and quiet in operation, a gathering station and any associated storage and export terminals needed for larger oilfields can be more noticeable. They will also take up more land. A gathering station which processes the oil from several wells may take up to four hectares. A rail depot or shoreside

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terminal, to which the oil would be brought by road or pipeline, might need a larger area of perhaps seven hectares.

In small oil fields, road networks are generally sufficient for the tanker transport of oil and gas to the refinery. For fields producing large quantities of oil and gas, a network of underground pipelines may be the most efficient option.

Routine operations at a well-managed production site generally cause little disturbance during production. Periodically, a smaller 'workover' rig may be used to conduct down-hole servicing to maintain production from a borehole. However, much of the other activity is invisible, in that it involves operation of the extensive pipework linking the wells to the processing, storage and distribution installations.

Using natural pressure within the reservoir alone, the operator will only be able to extract a proportion of the oil present. This is called primary recovery. A range of secondary recovery methods are used to increase the efficiency of oil production. For example, water or gas may be pumped into the reservoir to maintain the pressure, and, as previously mentioned, 'injection wells' may need to be drilled for this purpose. Ultimately, tertiary recovery methods using chemicals, carbon dioxide, nitrogen or heat may be considered.

2.5 Site Restoration and Aftercare

Oil and gas installations are decommissioned at the end of their working life. This involves the removal of all the buildings, plant and equipment. The petroleum industry is usually required to restore decommissioned sites to an agreed after-use. For an agricultural after-use, restoration will primarily involve the replacement of the soils, followed by aftercare of the land to encourage the redevelopment of soil structure and fertility. The reinstatement or creation of semi-natural habitats or forestry areas requires different restoration and after care programmes (see 4.2.3 'Well Site Abandonment and Restoration' below).

Chapter 3: POTENTIAL ENVIRONMENTAL IMPACTS OF OIL EXPLORATION ON LAND

The environmental implications of oil exploration may be far-reaching. The main issues of concern in relation to exploration in fragile tropical habitats are summarised below and in Figure 2. These provide the context for the environmental protection guidelines which follow.

3.1 Soil Erosion

Soils may have a high erosion potential due to soil structure, slope or rainfall. Left undisturbed and vegetated, such soils can maintain their integrity. However, poor design and construction standards for oil exploration roads, base camps, well sites, etc, can lead to substantial soil erosion.

3.2 Soil Contamination

Spillage or leakage of chemicals or oil may lead to soil contamination which will prevent revegetation or future arable farming on the site.

3.3 Removal of Vegetation

The removal of trees and vegetative cover is also conducive to soil erosion. This impact could be substantial unless there are strict limits to the amount of vegetation that can be cleared and unless there is revegetation of particularly exposed areas.

Even the removal of dead wood may indirectly accelerate soil erosion. For example, the removal of dead firewood by contractors may lead to the increased felling of living trees by the local population.

Removal of vegetation will also cause a visual scar on the landscape which may persist for a considerable time after exploration operations have ceased, especially if site restoration work is not implemented as part of the site abandonment programme.

Finally, of course, the loss of vegetation itself may be serious, particularly in situations where either a high proportion of the nutrients in an area are held in the vegetation (e.g. tropical rain forest), or where the few trees present are vital for wildlife browsing (e.g. tree savannah).

3.4 Pollution of Water

Both ground water and surface water can become polluted during drilling activities. Water contamination is particularly important where the water is used for household purposes by the local population, where it will affect the local fishing industry or in ecologically important areas. Apart from the obvious risk of a blow-out or major spill, the main risks are:

- Contamination of ground water from drilling fluids and oil during the drilling of wells.
- Leakage from unbunded liquid storage vessels.
- Contaminated site drainage.
- Liquid waste discharges associated with exploration operations.

Figure 2: SUMMARY OF POTENTIAL ADVERSE IMPACTS OF OIL EXPLORATION

Soil	Erosion due to construction activities, contamination with oil, drilling mud and effluents.
Vegetation	Loss of vegetation due to construction of access tracks and drill sites. Extensive vegetation loss due to fire. Facilitation of encroachment in forests.
Water	Contamination of surface water with oil, drilling mud and effluents. Contamination of ground water with oil and drilling mud. Disruption of water courses or drainage.
Landscape	Visual intrusion of drilling rigs. Night lighting. Flaring of gas.
Air	Smoke from gas flare. Odour.
Noise	Noise from helicopter access and plant delivery. Noise from track access and plant delivery. Drilling noise, especially at night.
Wildlife	Increased poacher access. Disturbance of wildlife. Pollution of water sources.
Communities	Disturbance of previously remote communities. Pollution or loss of vital natural resources. Introduction of diseases.
Culture	Damage to sites of archaeological, historical or cultural importance.
Infrastructure	Truck damage to dirt road and watercourse crossing points.
Secondary Impacts	Settlement, logging or mining induced by new access.

The construction of facilities could also cause disruption to local water courses and may affect water supplies if these factors are not considered at the design stage.

3.5 Visual Intrusion

The natural beauty and solitude of wildlands and their attractiveness to tourists can be greatly diminished by poor design and positioning of exploration operations, including roads and tracks, as well as major installations such as well-sites and base camps. Night floodlighting can also be visually intrusive, as can the gas flare.

3.6 Air Pollution

A certain amount of flaring of associated gases is normal during well testing in exploratory drilling and appraisal operations. Poor design can lead to black smoky flares. Strict limits are usually placed upon the quality and frequency of flaring. Flaring can also lead to odour, especially if the well contains 'sour' gas or 'sour' crude. Where this is likely, special consideration should be given to the siting of wells and the treatment of waste gases. Flares can also be an important source of noise (see below).

3.7 Noise Pollution

Noise from low-flying aircraft during the aerial surveys will be transient and therefore generally acceptable. However, helicopters are likely to cause more alarm to wildlife and people than are light aircraft.

Noise during exploration and appraisal drilling operations can be substantial and may thus cause considerable nuisance if close to noise sensitive locations such as villages and safari camps, particularly if operating at night.

3.8 Bush Fire

There is always a fire hazard associated with drilling and production operations. An outbreak of fire during the dry season could cause major environmental damage if left unchecked or uncontrolled.

3.9 Road and Crossing Point Damage

Many of the existing roads and watercourse crossing points in an exploration area may be unsuitable for use during the rainy season. Previous experience has shown that, where industrial operators have used these roads during the wet season, crossing points have been destroyed, roads have been severely damaged and soil erosion problems have occurred along the roads. Often the cost of road repairs and establishing a second crossing point has not been borne by the offending road user.

3.10 Damage to Fossil, Archaeological and Cultural Sites

In remote areas, sites of archaeological, historical, religious or cultural importance may not be immediately obvious. Similarly, fossil-rich and other geologically interesting sites may be easily

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overlooked in the haste of exploration. Local advice on such sites must therefore be taken before moving into an area if irreversible damage is to be avoided.

3.11 Poaching

The development of easier access routes into previously remote areas and the introduction of local and foreign workforces into rich wildlife areas may lead to increased poaching, which may become a permanent burden on the wildlife resource.

3.12 Social Impacts

Increased access may similarly result in the disturbance of remote communities or the natural resources upon which they depend, and may introduce them to diseases against which they have no resistance.

3.13 Secondary Impacts

Improved access may result in subsequent secondary impacts comprising those outlined in 3.11 and 3.12 above, along with unplanned settlement and exploitation of natural resources, e.g. logging or mining.

3.14 Planning Conflicts

The prospect of oil industry development may conflict directly with existing plans for the protection or development of an area, or may inflate land prices with similar effect. With care, it may be possible to build oil exploration into existing regional or national development plans. There may also be opportunities to rationalise facilities such as road networks to minimise the ultimate number of roads in protected areas or to bring forward planned infrastructure development.

Chapter 4: ENVIRONMENTAL PROTECTION

Oil exploration within fragile habitats requires a comprehensive approach to environmental protection, encompassing:

- **Management methods** which integrate environmental and operational requirements throughout the exploration process.
- **Specific environmental protection measures** which provide practical guidance on the avoidance of adverse environmental impacts.
- **Formalisation of environmental management procedures** and environmental protection standards/measures by written contract.
- **Monitoring and enforcement** of any agreements, codes of practice, emission/effluent standards and environmental quality objectives that have been applied to specific campaigns of exploration.

These aspects are individually addressed in more detail below.

4.1 Environmental Management

Environmental protection measures to prevent or minimise the environmental risks outlined in Section 3 can only be successfully implemented if they are set within a strong environmental management framework. Key factors in the establishment of this framework are:

- Consultation/liaison.
- Identification of sensitive locations.
- Environmental assessment.
- Management of operations.
- Restoration and aftercare.

There should be a strong commitment to consultation between oil company and government departments at all levels and the local community, at all stages of operations. Establishing common ground between the various interests through consultation can ensure that development proceeds in an acceptable way. The identification of especially sensitive locations enables avoidance strategies to be formulated and implemented in the planning stages.

The first step in the consultation process is for the oil company to communicate with appropriate government authorities responsible for agriculture, environment, forests, water, natural resources, wildlife, tourism and planning. Initially, information will be required on the following:

- **Location and status of protected areas** including World Heritage Sites, national parks, game reserves, forest reserves and tribal/communal areas within or adjacent to the exploration area.

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- **Existing planning policies and development plans** for the area, e.g. National Conservation Strategies, Regional Masterplans, National Park Management Plans, Communal Area Development Plans, Forestry Policies and Water Resource Development Plans.
- **Land tenure information**, e.g. land ownership, rights of access, communal land, seasonal grazing/cultivation practices and existing concessions granted in the area, e.g. for mining, logging or water abstraction.
- **All federal, state and local legislation relating to the environment.** (Summaries of existing legislation are available from the IUCN Environmental Law Centre in Bonn – see inside back cover.)

Local liaison is also critical. Each survey team should have a local liaison officer conversant in the local language. He will explain the exploration process to local communities before it begins, obtaining information on their land rights, cultural sites, seasonal activities and personal concerns. This liaison with local communities should be maintained throughout the period of exploration.

It should be the responsibility of the oil company to conduct an environmental impact assessment prior to each campaign of oil exploration. Environmental assessment should ensure that proposed exploration operations are set within their national and local context. It should provide the information needed to determine whether a project is environmentally acceptable, where it should be sited, how it should be designed and operated and what should be done with the site on decommissioning to restore or enhance its quality.

A commitment to sound management of exploration operations is an important factor determining the environmental acceptability of those operations. Once a decision on the location of operations has been made, the risk of environmental damage can be reduced through careful site selection and layout. Equally, the type of drilling and production equipment selected can have a significant influence on the acceptability of a given site.

Management plans should include local liaison and monitoring activities, training and contingency planning and provision for responsible supervision of all operations. Each operational site should have written safety management and environmental protection procedures and a written accident management plan with which all site workers are familiar.

Site restoration and aftercare is an essential part of the environmental management framework for exploration operations. This final stage should ensure that restoration is integrated with any future developments in an area (see 4.2.3 'Well Site Abandonment and Restoration' below).

4.2 Environmental Protection Measures

The measures described below represent current good practice within the oil industry and should not be viewed as an unreasonable burden upon exploration contractors. These environmental protection measures are summarised in Figure 3.

4.2.1 Remote Sensing

Aerial photography and aerial geomagnetic survey techniques are not likely to be of environmental significance. Any disturbance due to low level flying will be transitory and therefore unlikely to merit restriction, other than a ban on early morning/late evening flying.

4.2.2 Seismic Survey

This phase of exploration has the potential for the most severe environmental impacts in remote and fragile habitats, particularly in wildlife conservation areas and forests.

Access to the survey area itself may result in the most important impacts arising from the clearance of vehicle tracks and establishment of small base camps (see 3 above).

The direct effects of gaining access to the survey areas should be reduced by:

- Using the existing road network.
- Using boats to access areas adjacent to major rivers, lakes or coasts.
- Using helicopters or light aircraft to access particularly remote areas (but note noise disadvantage of helicopter use).
- Restricting the size of any camps to the absolute minimum.

The use of all terrain vehicles such as trials motorcycles for access to more distant points is often the most convenient method of minimising the scale of track/road construction.

If roads must be established, then they should be constructed with due regard for their potential environmental effects. Recommendations to minimise the impact of roads are given under para 4.2.3. 'Access'.

Shot hole seismic survey techniques should be used instead of vibroseis wherever practicable as this will avoid the extensive vegetation clearance and grading along trace lies required by vibroseis teams.

During shot hole seismic surveys in remote areas, access for seismic teams is usually on foot and hand carried equipment is used. The survey lines need to be cleared of obstructing vegetation to provide a footpath 0.5-1 m wide, but detours should be made around large trees which may be of high conservation or timber value and should not be felled. In settlement areas, the disturbance or loss of agricultural crops may be unavoidable, but compensation should be paid.

The explosions are safe but may cause noise disturbance in inhabited areas. The oil company would therefore be expected to give prior warning when operating in inhabited areas.

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The oil company representative must take full responsibility for the actions of all survey personnel including subcontractors who must be provided with specific instructions forbidding hunting or building fires.

4.2.3 Exploratory Drilling

As with seismic surveying, the oil company should discuss its plans for exploratory drilling with national and local authorities prior to any construction works for road or well facilities. This will provide an opportunity to resolve any land use conflicts and modify the initial proposals if necessary.

Contractors would be required to comply with all existing environmental protection legislation. However, they should also take into consideration the potential environmental impacts referred to in Section 3 and plan for their avoidance or minimisation.

They must also plan for the **prevention** of the following potential impacts:

- bush fire;
- pollution of ground water;
- pollution of surface water;
- land contamination.

The following recommendations relate to the actions needed for individual elements of the exploratory drilling process:

Access

Exploratory drilling will often require the establishment of a more permanent access road unless, due to remoteness or the sensitivity of the area, a helirig is to be used.

Roads should be carefully planned to avoid steep slopes and water courses. In undulating topography, cut and fill operations should be minimised. Slope engineering should incorporate preferential drainage courses or culverts, lined where necessary to prevent erosion. The extent of vegetation clearance should be kept to a minimum and exposed soil should be revegetated.

Once built, roads are rarely removed and will remain as a means of access for many years. It is therefore important that the route should be planned to minimise access to resources which are protected, e.g. certain peoples, forests, minerals, wildlife, etc. Encroachment is an insidious process which will occur unless actively designed against and controlled. It is also important that the siting and building of any new roads is integrated with any future development plans.

If new roads are likely to assist poaching or encroachment, then physical road blocks or removal of bridges may be necessary after exploration. New tracks may be stopped short of junctions with existing roads in order to camouflage their presence. In wildlife or forest conservation areas further support to staff may be necessary e.g. for the establishment of new ranger posts on new access points into a conservation area.

Where access roads take cultivated land, compensation must be paid.

Whilst helicopter noise is not welcomed in conservation areas, helicopter access to exploration drilling sites should be considered, to avoid the need for new roads. However, the use of helirig equipment will often require the clearance of an additional area at well sites to provide a helicopter flyway (usually 150 m x 50 m on either side of the well site). This may lead to restrictions on well site location. In forest areas, the additional clearance of a flyway will almost always be preferable to the cutting of a new road.

Base Camp

Base camps usually require about 1000 m² of land, but the area should always be minimised. The base camp site should be selected to minimise impact on wildlife, local communities, cultivated areas and tourism interests. As the site will only be used for a few months it should be selected with abandonment and after-use in mind. In this respect, the provision of a cleared area with hard-standing may be welcomed by the local people in an inhabited area. Alternatively, in a previously undisturbed area, the site should have potential for recolonisation by scrub and trees (see section on restoration below).

Waste disposal is a common problem for base camps in remote areas or where effluent treatment and waste disposal facilities do not exist or are poorly managed. Where solid and liquid waste treatment facilities are available, base camp wastes should be transported to these for treatment and disposal. In the absence of such facilities, a major concern must always be the control of pests, disease and contamination from wastes. Food wastes, packaging and other organic material should therefore be collected regularly and incinerated, and the residue buried in such a way that it cannot subsequently be exposed by livestock or wildlife.

Sewage can be treated in mobile facilities and finally disposed of through a soakaway system, but only if there are no sources of groundwater used as a drinking water supply in the vicinity. Packaged biological treatment plants, e.g. those incorporating RBCs (rotating biological contactors), or fibreglass septic tanks are to be preferred to any chemical treatment systems. Slow disposal of final effluents is preferable to sudden, large volume releases. Liquid wastes should never be disposed of directly into a watercourse (lake or river), nor should soak-away systems be established where they will rapidly drain into a watercourse without a reasonable residence time for attenuation.

Effluent water quality standards should be imposed and effluents monitored periodically to ensure compliance. (Actual standard selected will depend upon situation.) The oil company should routinely carry out this monitoring, but it is also important that spot checks are carried out by government staff. These standards are particularly important in inhabited areas where drinking water supplies may ultimately be affected, or where nutrient inputs could have an unwelcome effect on wetland/lake ecosystems.

Well Site Selection

The well site should be selected with existing land use, drainage and subsequent restoration in mind. The most important physical constraints will be slope and proximity to water courses, both of which have implications for drainage and associated erosion. Where possible a minimum separation of 250 m should be observed between the well site and any watercourses or drainage routes.

There is usually sufficient flexibility in well site location to allow the selection of a sensible site. The well site should be located to minimise impact on landscape, conservation interests and land uses, such as wildlife foci, settlements, cultivated areas and tourist interests. The well site and

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timing of operations can often be selected to accommodate existing land uses, for example by allowing the local people to harvest crops or extract valuable timber from the well site prior to the commencement of site works.

As exploration well sites may only be occupied for a short duration, the immediate impacts of drilling operations are often less significant than potential long-term impacts. In this respect the well site should be selected primarily with ease and speed of restoration in mind. Restoration should be compatible with an agreed after use. It should be recognised that the most appropriate exploration well site need not necessarily dictate the location of the subsequent production well site should a discovery be made. A minimum impact location for a short-term exploration well site may not be appropriate for long-term production.

When operating in a wooded or forested area it may be possible to locate the well site in a previously cleared area or natural clearing. If an area has been previously disturbed, then existing roads and clearings should be exploited rather than undisturbed areas where environmental impacts would be very much greater. Otherwise a site of least ecological value or low diversity should be sought.

If operating in a previously undisturbed area, then it is unlikely that a low-diversity or minimum impact well site could be readily identified without the use of ecological expertise.

Well Site Preparation

The preparation of a well site will often determine the success of its environmental management and subsequent restoration. Well sites are usually constructed on a square approximately 100 m x 100 m. The land is cleared of vegetation and the site graded to provide a level working surface of compacted soil materials or gravel.

However, these traditional procedures need to be re-examined to assess their suitability for environmentally sensitive locations, as follows:

- Well sites should be reduced in size wherever possible to minimise physical disturbance and reduce the area to be restored. The well site does not need to be square; there are considerable advantages in the site having an irregular outline with areas of undisturbed vegetation retained within the site where possible.
- The well site may not need to be completely levelled. On sloping ground consideration should be given to split-level or partially levelled sites to provide a more stable land form which is less susceptible to erosion.
- Prior to any levelling activities, the grasses and herbs on the site should be clipped and the seed heads retained for re-vegetation after the removal of drilling equipment.
- When vegetation is cleared this should not be automatically burnt or sold. The cleared wood may provide valuable material for the protection and stabilisation of earth slopes and banks from erosion, and it can be used to form barriers to prevent off-road vehicle access to undisturbed areas. Furthermore, brush wood can provide a valuable source of plant seed and mulch for the replacement of vegetation on the site. It should therefore be stored for site restoration.
- The depth of the organic top soil layer should be determined prior to grading and levelling of the site. The topsoil layer should be separated from the underlying sub-soil

during site levelling and grading. Mixing of the topsoil with sub-soils should be avoided as a priority. The topsoil should be stored in a loose pile on the edge of the site with the brush wood, and protected from compaction by vehicles. Topsoil protection could be achieved using strategically placed log barriers derived from site clearance if available.

- Slope engineering should incorporate preferential drainage channels which may require lining (e.g. with concrete) to prevent erosion. Channel discharge points may similarly require engineering to dissipate water discharge velocity and reduce erosion potential. All exposed slopes should be revegetated as a priority; stabilisation using geotextiles may also be necessary in certain circumstances. Interceptor channels for water drainage should be directed away from working areas and areas of chemical or fuel storage.
- The shape and grading of the working area itself should be designed to follow the local pattern of drainage, bearing in mind the intensity of rainfall, and the potential for surface flooding and run-off. Siting of the well, together with off-site bunds and drainage channels, should prevent water flow across the site. It may be necessary to intercept drainage and direct this away from the site. Water should not be allowed to flow into or through mud pits.
- In areas of standing water or a high water-table, an alternative approach to site preparation may be required. In these areas the well site and drill platform can be established on a wooden corduroy base. No site levelling is required because of the flat terrain, and the soil profile will remain intact and undisturbed beneath the corduroy. In these circumstances additional safeguards are required to prevent contamination by chemicals, fuel oil and produced crude oil.
- Water movement off-site should be controlled by an interceptor ditch. The interceptor will collect well site run-off water for inspection prior to discharge. In higher rainfall areas a holding tank may also be required to retain any contaminated run-off for treatment or collection.
- All fuel, oil and chemical storage areas should be bunded and sealed to contain any spillages and facilitate clean-up. Good housekeeping is also essential in storage, handling and use of fuel and chemicals.
- Crude oil from well testing should be stored in temporary tanks. All pipework and manifolds should be oil tight. Under no circumstances should oil be spilled or discharged on-site, or dumped in the mud pits.
- A store of equipment for oil spill clean-up should be maintained on-site. Any oiled soils and materials should be excavated and taken away for disposal or incinerated alongside solid wastes in areas lacking waste disposal facilities. Care is required in the siting and control of incineration so that it does not result in bush fire.
- To avoid contamination of groundwater or water courses, especially where they are exploited for potable water nearby, the mud pits will need to be lined and a sealed well cellar used.

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Waste Handling

The control, treatment and disposal of domestic solid and liquid wastes has been referred to under the Base Camp details. In summary, waste management should be by removal to an authorised waste treatment or disposal site wherever these are available.

The principal industrial waste arising from drilling operations will be 'spent' drilling-mud. Where local waste disposal facilities are available, the mud can be dewatered, the water tankered to a water treatment plant, and the spent mud and cuttings disposed of to an authorised landfill site. However, waste disposal facilities are often not available and drilling-mud disposal must be managed on-site.

The environmental significance of drilling muds is determined by their formulation. All muds employed in land exploration are normally fresh-water formulations. The majority of freshwater polymer, starch-based and bentonite muds are of relatively low toxicity. However, it should be noted that a number of chemical additives contain compounds which can be toxic in the short or long-term. Barite (90% BaSO₄) can contain lead impurities and chrome-lignosulphonates can introduce heavy metal contamination. The toxicity of chrome-lignosulphonates is such that they should not be used in remote/rural tropical situations where they cannot be properly disposed of.

For the majority of freshwater polymer, starch-based and bentonite muds the main environmental concern arises from water soluble contaminants; high concentrations of sodium, potassium and chlorides can be present in the mud fluid. At the concentrations normally found in undiluted mudfluids, these chemicals are toxic to vegetation and aquatic life. Under no circumstances should drilling mud fluid be discharged directly into a water course (lake or river) or pumped over the ground surface. Drilling mud fluids are best disposed of through a slow 'dilute and disperse' process. However, this should not be undertaken if groundwater is used or is likely to be used by wildlife or as a potable water supply nearby. If fluids are to be conducted to a distant disposal site they should be contained within discharge pipelines or road tankers to prevent spillage.

Mud pits should be constructed with sufficient capacity to contain all waste mud cuttings plus a contingency for rain water. The mud pit should be surrounded by a raised bund which prevents ingress of run-off water from the well site and adjacent areas. Mud pits should be constructed from impermeable soil materials. Construction should be assessed on a site by site basis to determine whether an additional liner is necessary to prevent seepage of fluids. Seepage of drilling mud fluids must not be allowed in areas of high groundwater table or where watercourses are close by. Under no circumstances should the mud pit be allowed to overflow. The mud pit should never be used for disposal of oily wastes or sewage effluents.

Well Site Abandonment and Restoration

In many remote tropical locations the oil industry has had a very poor standard of well site abandonment and restoration. Well sites have often been abandoned with no attempt at restoration in an unsightly and unsafe condition which is not acceptable.

The site should be abandoned in a safe condition. For a dry hole, this means sealing the well to the ground surface. The concrete well cellar should be broken up and removed to at least 1m below the ground surface and the cellar cavity infilled with subsoil removed during site levelling.

If necessary the site surface should be broken up to produce run-off and drainage characteristics compatible with surrounding land. For a sloping site, consideration should be given to restoration of the original contours. As a minimum, the site should be left with contours which will not erode or act as a focus for instability.

Following the establishment of compatible contours and drainage, all equipment and debris should be removed. At this stage the topsoil stripped from the site should be spread evenly over the surface. Seeding and revegetation should be conducted as appropriate, possibly protected by a cover of brush wood saved from the original vegetation. It may be necessary to retain some large logs in slopes and banks to aid stability and reduce erosion. Depending on the sensitivity of the site, a moderate fertiliser application may be considered as an aid to plant establishment. Alternatively, the seed mix should contain leguminous species to initiate nitrogen fixation (along with seeds retained at the time of site preparation).

Mud pits should be infilled and restored. Where possible the waste mud and cuttings should be excavated and disposed of to an approved disposal site. Where disposal facilities are not available, the mud pit should be infilled to form a stable surface without displacing or spilling the waste mud. The finished surface of the mud pit should be contoured and restored in line with the rest of the well site using stripped top soil, seed and brush wood as appropriate.

Any new or improved access roads should be treated as described above under the heading 'Access'.

4.2.4 Appraisal Phase

If a significant oil discovery is made then further appraisal wells may be needed. At this stage the location of the discovery well site should be reviewed to determine whether or not it will be a suitable appraisal and production site. The location and construction method for each appraisal well site should be carefully examined as it is more likely that they will be in long-term use. Any additional road access should be planned and constructed to the highest standards.

Generally, exploration boreholes need to be drilled from a site immediately above the point where a suspected oil reservoir is likely to be closest to the surface. Once a reservoir has been identified, however, further appraisal and production boreholes can be drilled from sites away from sensitive areas or clustered around acceptable sites by employing deviated drilling techniques. (The cost of drilling a deviated hole can be 50% higher than drilling a vertical hole to the same depth).

4.2.5 Development and Production Phases

Following appraisal drilling, oil field development planning will commence. A detailed Environmental Impact Assessment should be conducted prior to the development of the discovery. (This is outside the scope of the present guidelines.)

4.2.6 Opportunities for Improvement

Oil exploration may provide opportunities for improvements incidental to its main purpose and it is worth giving thought to this at the planning stage. The likely areas of improvements are as follows:

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- Upgrading of existing roads to all-weather quality, the construction of new all-weather roads and the provision of planned roads earlier than scheduled where these coincide with exploration access requirements (in liaison with transport authorities).
- Provision of bridges at river crossing points associated with upgrading to all-weather conditions (see also section 4.2.3 'Access' concerning the removal of bridges or avoidance of bridge-building to prevent secondary impacts of access).
- Provision of additional boreholes where water supplies are required to supply base camps and drilling sites, etc (in liaison with the water resource development authorities).
- Provision of dual use buildings, which, after occupation can be left to provide accommodation for schools, clinics, stores etc.

These improvements would be at little additional cost to the oil company. The possibility of these and other types of improvements should not be overlooked during the consultation and planning stages, as any actions which benefit the locality or the local people will help to compensate for any disruption and inconvenience caused by exploration activities.

However, in sensitive areas such as forests, any such improvement initiatives should be considered within the context of their ability to stimulate encroachment and other unwelcome secondary impacts, as referred to in section 3.13 above. (Such potential impacts should be carefully considered by the oil company before agreeing to road construction as a *quid pro quo* for permission to undertake exploration.)

4.3 Formalisation of Environmental Management

It is necessary for oil exploration companies to be committed to their environmental management and protection procedures by formal agreement with the relevant government authorities. The agreement should include:

- An agreement to full consultation between the company and all interested parties, both at government and community level.
- A requirement to perform an environmental impact assessment prior to each campaign of seismic survey, prior to test drilling and prior to development and production activities. The environmental impact assessments will need to be carried out in stages as work progresses.
- Agreement to issue appropriate environmental regulations and guidelines to, and otherwise train their employees and subcontractors so that they are aware of the environmental consequences of their actions. Compliance with such environmental guidelines must be made a condition of contract for all sub-contractors.
- Agreement to designate an environmental focal point person for the duration of exploration. This person would have overall responsibility for environmental management and act as liaison officer with government authorities. The environmental responsibilities of key exploration personnel should be clearly defined.

- Written oil spill and fire contingency plans must be drawn up and agreed with the government. Special consideration should be given to the type and use of any detergents and dispersants in clearing up oil spills, according to the habitat concerned.
- Special provisions should be made for activities which may occur near rivers, lakes and coasts. Special consideration must be given to the disposal of cuttings in sensitive locations.
- The responsibility for any necessary site restoration or remedial work should be clearly established in the concession agreement.
- Standards for emissions to air, liquid effluents and noise are to be set by the government and included in the agreement.
- An in-house monitoring programme must be specified for air quality, water quality and noise.
- The government, or an appointed independent body, should be specifically permitted to take spot samples or measurements to ensure that agreed standards are being met.
- The agreement should make provisions, general and specific, for the protection of archaeological, paleontological, historical, religious or cultural sites.

4.4 Monitoring and Enforcement

Any agreement established between an oil company and a government should be enforceable at law. Where possible, it should therefore have authority under the statutes and regulations of existing laws relating to mines and minerals, national parks and wildlife, local government and lands, industry, labour, public health and housing.

At the operational level, the primary responsibility for monitoring compliance with the agreement must lie with the oil company representative and through him, the environmental specialist appointed under him. Environmental training, clear definition of the environmental responsibilities of all key personnel and a manual summarising the environmental regulations and guidelines will all help to ensure compliance without resorting to enforcement.

Day to day monitoring of the contractor's activities will be carried out by the appropriate local or national authorities appointed by the government or the authorities responsible at law for such environmental protection.

The government or an appointed independent body should conduct periodic environmental audits which will determine whether the terms of the agreement are being met. In the event of unacceptable environmental damage or hazard, the appropriate action can then be taken, including halting exploration.

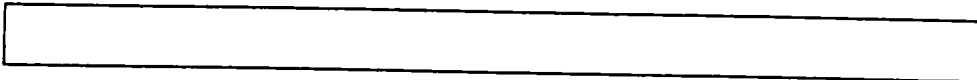


Figure 3: SUMMARY OF ENVIRONMENTAL PROTECTION MEASURES

IDENTIFYING RESERVES	- Shot hole method usually preferable to vibroseis in most situations. - Access to survey sites by methods of minimum disturbance and minimum construction of new infrastructure. - Minimisation of base camp size/facilities.
EXPLORATORY DRILLING	Access - 'Helirigs' preferable in sensitive areas. - New access routes to be planned to minimise subsequent national park/forest encroachment and exploitation/ disturbance of natural resources and people. - New tracks/roads to be planned and constructed to minimise erosion potential and vegetation loss. - New access routes to remain unconnected to main feeder roads. - New access routes to be physically blocked after use, where appropriate. - Support for park/forest ranger services where appropriate. - Compensation for loss of agricultural land. Base Camp - Planning for after-use at site selection stage. - Minimisation of land take. - Export of solid and liquid wastes to treatment facilities. - Alternatively, treatment of liquid effluents and incineration of solid wastes on site. - Final effluent of controlled quality and disposed via 'soakaway', avoiding potable water sources.
WELL SITE SELECTION	- Siting to minimise impacts on water resources, conservation interests, settlements, agriculture and landscape. - Consideration of subsequent restoration within site-selection. - Selection of site that is previously cleared/disturbed or of low ecological value. - Application of ecological expertise in site selection.

Figure 3: SUMMARY OF ENVIRONMENTAL PROTECTION MEASURES

WELL SITE PREPARATION	- Minimise cleared area. - Collection of seeds from site prior to clearance. - Storage of bushwood for erosion control, etc. - Minimise levelling activities. - Separation and storage of topsoil for subsequent restoration. - Engineering of slopes and drainage channels to avoid erosion. - Bunding and drainage design to avoid contamination of surface water. - Use of wooden corduroy drill platform in wet areas. - Interceptor ditches for site run-off. - Bunding and sealing of all fuel, oil and chemical storage areas. - Produced oil stored in sealed tanks/pipes. - Provision of oil spill clean-up equipment. - Mud pits to be lined and to have contingency capacity.
INDUSTRIAL WASTE HANDLING	- Separation and export of drilling mud solids and liquids for proper disposal when possible. - Toxic chrome-lignosulphonates not to be used in areas without disposal facilities. - Drilling mud fluids to be disposed of by soakaway only if water courses or aquifers are not at risk.
WELL SITE ABANDONMENT AND RESTORATION	- Sealing of well and removal of all structures. - Site surface contouring, restoration of natural drainage characteristics and replacement of top soil. - Stabilisation and re-vegetation. - Extraction and proper disposal of drilling muds and infilling of mud pits. - Severance or obstruction of access road, if appropriate.
APPRAISAL	- Detailed planning of location and construction method and after-use of each appraisal site.
IMPROVEMENT	- Where appropriate, design and construction of roads, bridges, water-supplies and building for subsequent use by local communities.

GLOSSARY OF OIL INDUSTRY TERMS

abandon (a well)	To cease work on a well and seal it off with cement plugs.
aftercare programme	A management programme which follows the decommissioning and restoration of a site to ensure that full restoration to a predetermined after-use is achieved.
appraisal well	Well drilled after a hydrocarbon discovery to delineate the extent of a reservoir, and to test its productivity and properties.
barrel	Unit of measurement equal to 35 imperial gallons or 42 US standard gallons (159 litres).
bentonite	A naturally occurring clay, which is often a major constituent of drilling muds.
blow-out	Occurs when gas, oil or salt water escapes in an uncontrolled manner from a well.
blow-out preventer (BOP)	A hydraulically operated device fitted to the top of wells to seal off the well should a blow-out situation develop.
cap rock	Impervious layer of rock overlying reservoir rock which prevents leakage of the oil or gas to the earth's surface.
casing	Steel tube which is cemented into an oil well to prevent the collapse of the well and possible contamination of the groundwater.
christmas tree	An array of pipes and valves fitted to a production wellhead to control the flow of oil and gas and to prevent blow-outs.
contingency planning	Procedures developed by an operator which provide a strategy for dealing with unplanned events, for example oil spillages or blow-outs.
crown block	A fixed system of pulleys fitted at the top of a derrick for use in raising and lowering the drill string, casing etc.
crude oil	Oil produced from a reservoir after any associated gas has been removed, often simply referred to as 'crude'.
derrick	The elongated pyramid of latticed steel mounted over a borehole for drilling and well servicing purposes.
development well	Well drilled in a formation for the purpose of producing oil and gas. (Also called a production well).
deviated or directional drilling	Controlled progressive deviation of a well away from the vertical in order to reach different parts of a reservoir from a single drilling site.
drill bit	The part of the drilling tool which actually cuts through the rock in the drilling of a borehole or well.

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drill stem test	A test during which the nature and quantity of the formation fluids in a possible oil- or gas-bearing stratum are determined by allowing them to flow to the surface through the drill string under controlled conditions.
drill string	Lengths of steel tubing roughly 10m long screwed together to form a pipe connecting the drill bit to the drilling rig. The string is rotated to drill the hole and also serves as a conduit for drilling mud. (Also called drill pipe).
drilling mud	Specialised fluid made up of a mixture of clays, water (and sometimes oil), and chemicals which is pumped down a well during drilling operations to lubricate the system, remove cuttings, and control pressure.
drilling rig	The complete machinery and structures needed for drilling a well (the most visible component being the derrick).
drilling table	The table on the derrick floor with which the drill string is rotated. (Also called the rotary table).
dry hole	A well drilled without finding gas or oil in commercial quantities.
enhanced oil recovery	A process whereby oil is recovered other than by the natural pressure in a reservoir, using secondary or tertiary recovery methods.
exploration drilling	Drilling carried out to determine whether hydrocarbons are present in a particular area or geological structure.
exploration phase	The phase of operations in which an operator searches for oil and gas by carrying out detailed geological and geophysical surveys followed up, where appropriate, by exploratory drilling in the most promising places.
flaring	Burning of gas extracted from an oil and gas reservoir which is not worth commercial production.
gas field	A hydrocarbon reservoir containing natural gas but no oil.
gathering station	A facility at which oil or gas from a number of wells in a producing field is collected, and where the oil, gas and water are separated, and products prepared for export from the area.
geophones	The detectors used in seismic surveys to pick up sound waves reflected from sub-surface strata.
injection well	A well used to inject gas or water into an oil/gas reservoir rock in order to maintain reservoir pressure during the secondary recovery process.
marginal oil field	A field that may or may not produce enough net income to make it worth developing at a given time; should technical or economic conditions change, such a field may subsequently become commercial.
nodding donkey	Pumping unit, used to extract crude oil from a reservoir which has insufficient internal pressure to force the oil to the surface.

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obligatory wells	Exploration wells that an operator undertakes to drill in a given area as a condition for being allocated an exploration licence.
oilfield	A productive oil or gas formation comprising one or more reservoirs, usually related to the same geological features.
primary recovery	Recovery of oil or gas from a reservoir by using only the natural pressure in the reservoir to force oil or gas out.
prospect	A geological feature which has the potential of containing oil and gas that merits further exploration work.
recoverable reserves	That proportion of the oil/gas in a reservoir that can be removed using currently available techniques.
reservoir	A stratum in which oil/gas is present.
reservoir rock	Porous and permeable rock, such as sandstone, limestone, or dolomite, containing petroleum within the small spaces in the rock.
restoration	The activities undertaken immediately after a site is decommissioned to restore it to a predetermined land-use.
rotary drilling	Drilling in which the entire drill string and bit are rotated, as opposed to turbine drilling where just the drill bit is rotated by a down-hole turbine.
secondary recovery	Recovery of oil or gas from a reservoir by artificially maintaining or enhancing the reservoir pressure by injecting gas, water or other substances into the reservoir rock.
seismic survey	A technique for determining the detailed structure of the rocks underlying a particular area by passing acoustic shock waves into the strata and measuring the reflected signals.
shale shaker	A vibrating or rotating screen which removes the coarse drill cuttings from the drilling mud prior to recirculation.
shot hole seismic method	Seismic survey which uses a small explosion down a shallow borehole to produce shock waves.
sour crude or gas	Oil or gas which has a high sulphur content.
spudding-in	The process of starting to drill a well by making a hole in the surface with a large diameter drill bit.
tertiary recovery	Recovery of oil or gas from a reservoir over and above that which can be obtained by primary and secondary recovery – generally involves sophisticated techniques such as heating the reservoir to reduce the viscosity of the oil.
vibroseis	A seismic survey technique which uses a large vehicle fitted with vibrating plates to produce the shock waves.
water injection	A process whereby treated water is pumped into the reservoir rock in order to maintain the reservoir pressure.

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wildcat well

A well drilled to find oil and gas in an unproven area on the basis of incomplete geological information.

workover

A process by which a completed production well is subsequently re-entered and any necessary cleaning, repair and maintenance work done.

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