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**MANAGEMENT REPORT AND RECOMMENDATION**  
**IN RESPONSE TO THE**  
**INSPECTION PANEL INVESTIGATION REPORT**  
  
**COLOMBIA**  
  
**CARTAGENA WATER SUPPLY, SEWERAGE AND**  
**ENVIRONMENTAL MANAGEMENT PROJECT**  
**(LOAN NO. 4507-CO)**

July 29, 2005

**MANAGEMENT REPORT AND RECOMMENDATION  
IN RESPONSE TO THE INSPECTION PANEL INVESTIGATION REPORT  
OF THE  
COLOMBIA – CARTAGENA WATER SUPPLY, SEWERAGE AND  
ENVIRONMENTAL MANAGEMENT PROJECT  
(LOAN NO. 4507-CO)**

Pursuant to paragraph 23 of the Resolution Establishing the Inspection Panel (IBRD Resolution 93-10 and IDA Resolution 93-6), attached for consideration by Executive Directors is Management's Report and Recommendation in response to the findings set out in the Investigation Report No. 32034-CO dated June 24, 2005, of the Inspection Panel on the captioned Project (Cartagena Water Supply, Sewerage and Environmental Management Project, Loan No. 4507-CO).

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**COLOMBIA  
CARTAGENA WATER SUPPLY, SEWERAGE AND  
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## **ABBREVIATIONS AND ACRONYMS**

ACUACAR	Aguas de Cartagena, S.A. E.S.P.
CARDIQUE	Corporación Autónoma Regional del Canal del Dique Regional Autonomous Corporation of the Dique Canal (regional environmental authority)
CAS	Country Assistance Strategy
CCH	Corporación Cartagena Honesta
EA	Environmental Assessment
FS	Feasibility Study
IBRD	International Bank for Reconstruction and Development
IDB	Inter-American Development Bank
INVEMAR	Instituto de Investigaciones Marinas y Costeras (Marine and Coastal Research Institute)
IPN	Inspection Panel
IPU	Impuesto Predial Unificado (Unified Property Tax)
OD	Operational Directive
OP	Operational Policy
PAD	Project Appraisal Document
PMR	Project Management Report
POE	Panel of Experts
SIA	Social Impact Assessment
USD	United States Dollar
WHO	World Health Organization
WTP	Willingness to Pay

## **CURRENCY EQUIVALENTS**

(Exchange Rate Effective June 30, 2005)

Currency Unit = Colombian Peso

CP 2,337.50 = USD1.00

**LIST OF OPERATIONAL POLICIES AND OPERATIONAL DIRECTIVES**

OD 4.01	Environmental Assessment, October 1991
OP/BP 4.04	Natural Habitats, September 1995
OP 4.07	Water Resources Management, July 1993
OD 4.15	Poverty Reduction, December 1991
OD 4.20	Indigenous People, September 1991
OP/BP 10.02	Financial Management, August 1997
OP/BP 10.04	Economic Evaluation of Investment Operations, September 1994
OD/OP/BP 13.05	Project Supervision, January 1996 and July 2001, respectively



## I. INTRODUCTION

1. On April 22, 2004, the Inspection Panel registered a Request for Inspection, IPN Request RQ04/02 (hereafter referred to as “the Request”), concerning the Colombia-Cartagena Water Supply, Sewerage and Environmental Management Project (“the Project”) financed by the International Bank for Reconstruction and Development (IBRD). The Request was submitted by the Corporación Cartagena Honesta (CCH, hereafter referred to as the “Requesters”) on its own behalf and on behalf of 125 residents of Punta Canoa, 139 residents of Arroyo de Piedra, 41 residents of Manzanillo del Mar, and 119 residents of Cartagena.
2. The Executive Directors and the President of IBRD were notified by the Panel of receipt of the Request. Management responded to the claims in the Request on May 21, 2004.
3. In its Report to the Board, the Panel found the Request eligible and recommended that the Executive Directors authorize an investigation. The investigation was authorized by the Executive Directors on July 13, 2004.
4. On June 24, 2005, the Panel issued its report outlining the findings of the investigation. Management appreciates the Panel’s clear and thorough presentation of its findings.
5. This report, responding to the findings of the Panel and including Management’s Action Plan, is organized in several sections. Section II briefly describes the Project and provides an update on Project status. Section III summarizes the findings and observations of the Panel. Section IV provides additional background information on several key issues. Section V presents the Action Plan and Section VI contains the conclusion. A detailed matrix containing the Panel’s findings, along with Management’s responses, is provided in Annex 1. Annexes 2-4 contain supporting materials.

## II. PROJECT STATUS

6. ***The Project.*** The Cartagena Water Supply, Sewerage and Environmental Management Project was prepared during the period 1995-1999, and approved by the Bank’s Board of Executive Directors in July 1999 (Loan No. 4507-CO). The total Project cost is USD117.2 million, which is financed by USD85 million in an IBRD Loan, with contributions of USD4.6 million from ACUACAR (Aguas de Cartagena, the water company), USD7.6 million from the District of Cartagena and USD20 million from the Government of Colombia. Three legal agreements are pertinent to the Project. The Loan Agreement with the District of Cartagena (the Borrower) specifies that the District will make the proceeds of the Loan available to ACUACAR, the Project implementing entity, with whom the Bank signed a Project Agreement. A Guarantee Agreement with the Republic of Colombia guarantees the payment obligations of the Borrower. All three agreements were signed in December 1999. The Project became effective in January 2000.
7. The Project consists of eight components:

- Component A. Expansion of the Water Supply System;
- Component B. Expansion of the Sewer System in the Ciénaga Basin;
- Component C. Construction of the Main Conveyance System of the Wastewater to the Treatment Plant;
- Component D. Construction of Treatment Installations;
- Component E. Construction of the Submarine Outfall;
- Component F. Industrial Wastewater Discharge Control;
- Component G. Environmental and Social Component; and
- Component H. Project Management, Technical Assistance, Studies, Design and Supervision of Works.

8. **Project Status.** The Project has been effective for approximately five and a half years. As of July 15, 2005, 42.4 percent of the Loan had been disbursed. The works of Component A (Expansion of the water supply system) and Component B (Expansion of the sewer system in the Ciénaga basin) have been completed. Most of the contracts have been closed and some are due to close in August 2005. Components F, G and H are well advanced, and will continue for the entire implementation period, as planned. The water supply works for the North Zone, originally the responsibility of the District of Cartagena, are now under construction, funded by the Project, due to savings achieved in the implementation of Component A. These works will be completed prior to or during the last quarter of 2005.

9. The implementation of Components C, D, and E, which constitute the wastewater management system, including the submarine outfall, has suffered delays due to the lengthy authorization of an environmental license for these works and an unsuccessful bidding process that has required rebidding. The works under these three components have been divided into four contracts: (i) the Paraiso pumping station; (ii) the onshore pressure pipeline; (iii) the wastewater treatment plant; and (iv) the submarine outfall. A first round of bidding for the four contracts was carried out in 2004. The price of the lowest evaluated proposal for contract (ii) was lower than the engineers' cost estimate and the bidding process was considered successful. The prices of the lowest evaluated proposals for contracts (i), (iii) and (iv) were much higher than the engineers' cost estimates and these bids were voided. Rebidding was carried out for contracts (i) and (iii) and has been completed successfully, the prices of the lowest evaluated proposals being less than the engineers' cost estimates. The documents for rebidding of contract (iv) are under preparation and the process is expected to begin in September 2005. The original closing date of the Loan was June 30, 2005; due to the delays resulting from the late authorization of the environmental license and the lengthy bidding processes, however, the closing date has been extended to June 29, 2007 to accommodate the duration of the contracts.



10. In the North Zone, a piped water system is under construction and will be delivered to the communities of Punta Canoa, Manzanillo del Mar and Arroyo de Piedra by September 2005. In-house sanitation is under construction in La Boquilla and Manzanillo del Mar, and under bidding for Punta Canoa, where delivery is projected for April 2006. La Boquilla has already been connected to the sewer network. ACUACAR has committed to extend the sewer network to Punta Canoa, Manzanillo del Mar and Arroyo de Piedra in the next 24 months, in parallel with the construction of the outfall. ACUACAR, with participation of the communities, plans to complete a study on strengthening fishing activities in the North Zone communities, by September 2005. This study, which draws on the 2003 Project financed study by INVEMAR (Marine and Coastal Research Institute), will identify specific activities to further optimize fishing opportunities. ACUACAR will support a program, using project funds, to strengthen fishing activities based on the results of the study. A plant nursery, financed by ACUACAR, has been established in Punta Canoa, to be managed cooperatively by the community to create jobs and supply trees that need to be planted in the Project area, in compliance with the conditions of the environmental license.

11. Due to the delay in Project implementation and the continuous flow of immigration of poor families to Cartagena, thirty-seven families settled during 2000-2003 on District property on the planned route of the onshore pressure pipeline, near the Paraiso pumping station. Although resettlement activities were not expected during Project preparation, it is now necessary to resettle these families. A Resettlement Action Plan was recently prepared and will be disclosed in accordance with Bank policies. The families are expected to be resettled by end 2005.

### III. FINDINGS AND OBSERVATIONS OF THE PANEL

12. The Panel made the following findings regarding Bank compliance with its policies and procedures in relation to the issues raised by the Requesters:

<b>OD 4.01 – Environmental Assessment</b>	
In compliance	<ul style="list-style-type: none"> <li>- Project screening and categorization</li> <li>- Initiation of Environmental Assessment (EA) at early stage in Project cycle</li> <li>- Analysis of alternatives – coverage of alternatives</li> <li>- Use of Panel of Experts (POE)</li> <li>- Consideration of alternatives and mitigation measures for land conveyance system (routing, pumping stations and treatment plant locations)</li> <li>- Monitoring program</li> <li>- Compensation for some potential impacts</li> <li>- Consultation efforts with people in Cartagena</li> </ul>
Not in compliance	<ul style="list-style-type: none"> <li>- Demonstration of systematic comparative study of all alternatives, in particular alternatives other than the submarine outfall</li> <li>- Consideration of alternatives for disposal of solids</li> <li>- Social evaluation and mitigation of potential impacts on local communities in North Zone</li> <li>- Consultations with affected communities in area of submarine outfall</li> </ul>
<b>OP 4.04 – Natural Habitats</b>	
In compliance	
<b>OP 4.07 – Water Resources Management</b>	
In compliance	

<b>OD 4.20 – Indigenous Peoples</b>	
In compliance	- Because of absence of two policy criteria, failure to regard Afro-Colombians as Indigenous Peoples “may not be deemed as noncompliance with the ‘judgment’ called for in OD 4.20, para 5”
Not in compliance	- Consultation with “specialized anthropological and sociological experts”
<b>OP/BP 10.02 – Financial Management</b>	
In compliance	- Project financial and accounting statements - Financial management assessment – ACUACAR - Financial capacity – ACUACAR - Risk of default on the Bank Loan
Not in compliance	- Financial management assessment for the District
<b>OP/BP 10.04 – Economic Evaluation of Investment Operations</b>	
In compliance	- Economic analysis broadly in compliance
Not in compliance	- Recalculation of costs of submarine outfall alternative in light of licensing requirement for primary treatment in ten years - Quantification of tourism benefits - PAD presentation of the economic analysis (cost benefit and sensitivity and risk analyses, distributional analysis and data reliability) - PAD demonstration of Project consistency with Bank’s poverty reduction strategy
<b>OD 4.15 – Poverty Reduction</b>	
Not in compliance	- Attention to risks and concerns of North Zone communities - Assessment of potential impact of Project on use of resources for other poverty reducing investments
<b>OD/OP/BP 13.05 – Project Supervision</b>	
In compliance	- Bank supervision of ACUACAR
Not in compliance	- Acceptance of audit reports per requirements of the Loan Agreement

13. In addition to the findings of compliance or non-compliance with various parts of the Operational Directives (ODs) and Operational Policies (OPs) cited above, the Panel made a number of observations in order to assist in “furthering the development of a sustainable and equitable waste disposal system.” These observations concerned the design of the outfall and the overland pipeline, impacts on and consultation with North Zone communities, the Social Impact Assessment (SIA), economic costs of alternatives and ways to have addressed financial management in the District of Cartagena. Detailed information is provided in Annex 1.

#### **IV. KEY ISSUES**

14. This section provides additional background information related to the Management Action Plan discussed in Section V below.

#### **Wastewater Disposal – An Environmental and Health Crisis in Cartagena**

15. The lack of sewage treatment facilities in the District of Cartagena causes serious threats to the environment and human health. Under the Project, increased collection, treatment and adequate disposal of sewage in the District will significantly diminish environmental health risks faced by the population as well as reduce the pollution of water bodies surrounding the city. Moreover, the sanitary disposal of wastewater is a key measure to reduce conditions of poverty among the urban poor. About 85 percent of Cartagena’s population of approximately one million inhabitants is classified as low and

medium-low income, of which nearly one-third is extremely poor. The city is a destination for rural Colombians displaced by violence in the countryside and looking for better economic opportunities. Cartagena's water and sanitation infrastructure has not kept pace with its population growth of about 2.5 percent per year.

16. The water bodies surrounding the city have become repositories of untreated municipal and industrial liquid wastes and are heavily polluted. About 30 percent of the untreated wastewater is discharged into Cartagena Bay, another 60 percent goes into the Ciénaga de La Virgen (an in-city coastal lagoon, hereafter called the Ciénaga) and 10 percent flows into water courses that traverse the city. Overflows from overloaded sewers contaminate the beaches and add to the pollution of the in-city water courses, while liquid and solid wastes from the industrial estate area further contaminate the waters of Cartagena Bay.

17. A population of approximately 400,000 residing in the poor neighborhoods around the Ciénaga and in part of the southwestern zone adjacent to Cartagena Bay suffers from the worst sanitation conditions; because of the lack of sewers, raw sewage flows in the streets. In addition, open storm water drainage canals carry sewage from other parts of the city across the poor neighborhoods on their way to the Ciénaga. As a result, Cartagena's poor population is exposed to about 60 percent of the city's untreated sewage. These deficient sanitary conditions affect the health of all and especially of children. Intestinal parasites and other intestinal infections are among the ten top causes of morbidity.

18. Projections indicate that Cartagena will more than double its sewage generation (to about 300,000 cubic meters per day) by 2025. Without adequate waste disposal, the situation will become disastrous. In addition to direct impacts on the population, public health, sanitation and environmental problems will continue to pose a serious constraint to economic development, especially in the tourism sector, which is a main income source in Cartagena.

19. As outlined in the Project Appraisal Document (PAD) (section C3, page 9) the Project aims to bring public health benefits in terms of sanitation services especially to the city's poor and marginal areas. In the poorest neighborhoods (San Jose de Los Campanos, El Pozón, Villa Estrella, La Boquilla, Paseo Bolívar, Zona Suroccidental and Zona Suroriental sub-basins, which currently discharge their sewage to the Ciénaga), approximately 80,000 people will directly benefit from investments in improved sewerage and increased water supply coverage. However, even in areas where sewers have already been installed, it is not possible to use these networks until there is adequate disposal. With the installation of the selected disposal alternative – the submarine outfall – the Project will reduce public health risks, especially for the poor, and pollution city-wide.

20. The Project's environmental benefits can be appreciated by comparing the current situation, prior to improvements in wastewater disposal, with the situation after construction of a wastewater conveyance system, treatment installation and submarine outfall. Map 1 shows the water bodies currently contaminated by raw sewage close to the

shoreline and the urban areas contaminated by sewage flowing in open storm water drainage canals in the streets. Map 2 shows the situation after construction of the wastewater management works, according to Colombian standards for water quality for primary and secondary contact.

21. As detailed technical studies and modeling efforts have shown (see Management Response to the Request, May 2004 and Annex 1 herein), the Project's benefits can be achieved without adverse impacts on communities of the North Zone. The alternative of preliminary sewage treatment and effluent disposal through a long, submarine ocean outfall offshore of Punta Canoa poses negligible risk to the health of the communities or to marine life at or near the outfall site (see Annex 1, Item 5). In addition, the Project contains specific actions as part of a Social Impact Mitigation and Community Development Program that will benefit North Zone communities, including in-house sanitation packages, connection to the sewer network and provision of water services. See Annex 1, Item 13, for additional detail.

22. Management will continue to work with ACUACAR to strengthen the outreach program and communications to the North Zone communities. This continuing outreach program aims to address those communities' perceptions of adverse impacts and explain further the overall benefits in which the communities will share both as residents of the North Zone and as commuters to and workers in the central part of the District.

### **Selection of the Wastewater Management Alternative for Cartagena**

23. *Process of Evaluating Alternatives.* The process of selecting the proposed wastewater treatment and disposal alternative for management of the wastewater of Cartagena was comprehensive and based on a widely accepted methodology. The result was the selection of an alternative combining preliminary treatment and a deepwater submarine outfall discharging effluent to the Caribbean. This alternative was the lowest cost, reliable, simple-to-operate solution to address the serious need for wastewater treatment in a city of approximately one million people that has no sewage treatment. Other alternatives would have been more costly and would not have yielded greater benefits.

24. To identify the appropriate least cost wastewater disposal solution, the multi-phased approach included a Feasibility Study for Wastewater Treatment and Disposal in Cartagena (FS), containing the analysis of alternatives (Hazen and Sawyer, 1998); Environmental Diagnostics of Outfall Alternatives for the Disposal of Wastewater in Cartagena (Hazen and Sawyer, 1998); the Social Impact Assessment of the Cartagena Sanitation Project (Vasquez and Baquero, 1998); and the EA for the Wastewater Management Plan of Cartagena (Fundación Neotrópicos, March 1999). (See Annex 1, Item 3, for the number of alternative treatment options, sites for an outfall, types of pipe material, outfall pipe diameters, land conveyance routes, and different diffuser depths evaluated in the FS.)

25. These studies were supplemented by evaluations from an internationally recognized independent POE, which reviewed the FS, EA and final design specifications

for the marine outfall, as well as ongoing studies after Project approval in July 1999. The POE held extensive discussions during six meetings of 2-3 days each during which it provided input to the FS and detailed design. All major decisions regarding the selection of the wastewater treatment and disposal alternative were endorsed by the POE, and the detailed design was also reviewed and endorsed by the POE.

26. **Rejected Alternatives.** Currently, Cartagena's raw wastewater flows untreated into Cartagena Bay and the Ciénaga de la Virgen. The wastewater flowing into Cartagena Bay heavily contaminates the bay and poses risk to the coral reefs located south of Cartagena. If the bay were to continue to be used to dispose of Cartagena's sewage, the wastewater would require costly, tertiary treatment<sup>1</sup> for removal of nutrients (nitrogen and phosphorus) and pathogenic organisms. A tertiary level of wastewater treatment would also be required prior to discharge to the Ciénaga. Consequently, the Bay and the Ciénaga are not viable options as the receiving bodies of Cartagena's wastewater.

27. In the early 1990s, the proposed wastewater management scheme for Cartagena entailed treatment of wastewater in oxidation lagoons and discharge of the effluent into the Ciénaga (from which it would eventually reach the sea). This was not considered an appropriate long-term solution for Cartagena for several reasons. Effluent discharge to the Ciénaga would cause eutrophication of its water and damage to the mangroves growing around it (tertiary treatment would be needed to prevent eutrophication). Wastewater treatment in oxidation lagoons is difficult to control if the biological process collapses or the lagoons become overloaded; large oxidation lagoons such as those proposed for Cartagena could become a problem for a large tourism and resort city. A lagoon scheme would also have substantial land requirements. Finally, the cost of treating Cartagena's wastewater in oxidation lagoons and discharging the effluent to the Ciénaga was found to be higher than the cost of the selected alternative.

28. Reuse of sewage effluent to irrigate crops was also not viable. Because there is abundant fresh water from the Canal del Dique, there is no demand for irrigation water in the area. Furthermore, there are additional treatment and other infrastructure costs to be borne and there is no institutional framework capable of handling such a system. The selected alternative of a submarine outfall does not exclude reuse of wastewater for irrigation in the future.

29. **Selected Alternative.** The selected alternative consists of pumping the raw wastewater from the Paraiso pumping station (see Map 1) to a plant where preliminary treatment of the wastewater occurs, and discharging the effluent to the sea offshore of Punta Canoa via an outfall 2.85 kilometers long and 72 inches in diameter, at a depth of 20 meters.

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<sup>1</sup> Sewage treatment levels are classified as preliminary, primary, secondary or tertiary. Preliminary treatment consists of removing coarse solids, floating materials and oil and grease by screening the wastewater and passing it through a grit removal chamber. Primary treatment removes settleable solids from the wastewater through the use of sedimentation tanks. Secondary treatment employs biological processes for removal of dissolved organic matter and fine solids from the wastewater. Tertiary treatment employs chemical processes and additional biological processes to further improve effluent quality.

30. The decision was made to utilize, during a first phase, preliminary treatment of the wastewater prior to its discharge to the outfall, coupled with an extensive monitoring program. A combination of preliminary treatment with an effective outfall is considered by the World Health Organization (WHO, 2003) to pose a low risk to human health. This alternative also meets Colombian and international standards. Primary treatment would have added about USD40 million to the cost of the Project and secondary treatment USD100 million. The selection was made partly because of cost, and partly because additional treatment beyond preliminary would not provide incremental benefits.<sup>2</sup>

31. Oceanographic studies were used to determine the best discharge site. The site offshore of Punta Canoa, which is located about 20 kilometers north of central Cartagena, was selected because the sea bottom slope is steep there, so the length of an outfall that reaches deep water is only 2.85 kilometers. Although Punta Canoa is located at the greatest distance from the center of Cartagena, the closer sites considered have gentle bottom slopes and would have required a much longer outfall (of about 9 kilometers) to reach deep enough water. The combined cost of the onshore and offshore/underwater pipes was lowest for the site offshore of Punta Canoa. Potential impacts on fishing examined in the EA concluded that biological activity in the outfall location was non-existent and that risks to the marine environment beyond the immediate discharge area are negligible. As explained further in Annex 1, Item 12, while fishing is important for many households in North Zone communities, the fishing practices of the communities are such that the fishers' livelihoods are not expected to be affected by the location of the outfall.

32. After selection of the outfall (1998) as the best disposal alternative, extensive oceanographic studies were carried out over a period of four years (1998-2002), to ensure that sufficient reliable data were available for the design of the outfall and other installations of the selected alternative.

33. ***Water Quality Impacts of Marine Effluent Discharge.*** Ensuring that effects of effluent discharge on receiving waters are minimal requires that concentrations of bacteria, viruses, toxic substances, and other contaminants be reduced to safe levels, products of the effluent (organic carbon, nutrients, etc.) and dissolved oxygen concentrations in the sea be maintained within allowable limits, and local particulate deposition not be excessive. The plume also must not be visible on the water surface. These requirements can be met by a suitable combination of outfall and diffuser location, effective dispersion and dilution of the effluent, and treatment level. If a diffuser causes rapid dilution and dispersion of effluent and is positioned so that transport of the discharged wastewater to critical areas (especially the shoreline) is minimized, only a preliminary level of wastewater treatment is needed. Efficient mixing of the discharged effluent and the sea water, resulting in dilution exceeding 100:1, can be achieved within the first few minutes after discharge. This reduces concentrations of organics and nutrients, which are characteristic of sewage, to levels that have no adverse ecological effects.

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<sup>2</sup> Notwithstanding the decision regarding the first phase level of treatment, there is a commitment, through the environmental license, to put primary or equivalent treatment in place by 2015.

34. Public health is protected by an effective design and location of an outfall so as to reduce levels of pathogenic organisms to meet established bathing beach water quality criteria. The required orders-of-magnitude reductions in the concentrations of pathogens are achieved through physical dilution and mortality of pathogens in the hostile ocean environment. As demonstrated by numerous studies, properly designed ocean outfalls discharging domestic wastewaters do not cause significant ecological impacts or public health risks.

35. **Treatment versus Outfall Length.** Coastal wastewater disposal is often posed as a choice between treatment and use of an outfall. This is a false dichotomy, as treated effluent is ultimately disposed of through an ocean outlet or to inland rivers that eventually flow to the sea, except in the infrequent cases of reuse or injection of effluent into saline aquifers. WHO (2003) has recently provided a comparison of the risks to human health from exposure to sewage for various disposal options (reproduced in Management's Eligibility Response as Table 3), which demonstrates that an effective submarine outfall has advantages over near or short outfall discharges, even when those discharges have primary, secondary or tertiary treatment. The WHO information also shows that discharge through an effective outfall with only preliminary treatment has low risk, and increasing the level of treatment does not substantially lower the risk.

36. For example, an initial dilution of 100:1 (this corresponds to a 99 percent reduction in contaminant concentrations) achieved by an outfall such as the one proposed is beyond the capabilities of conventional secondary treatment for removal of organics and nutrients. The diffuser mixing is, therefore, usually more important than treatment. This mixing can reduce pathogens to levels comparable to or better than those achieved by chlorination of secondary effluents. Furthermore, biological treatment processes are subject to upsets that can result in direct onshore or near-shore discharge of raw wastes. Discounting structural outfall failure (rarely encountered in modern designs), such discharges could not occur with the use of effective, offshore outfalls. These systems can also be designed to handle large seasonal variations in sewage flow resulting from the presence of transitory populations in tourist areas.

### **Economic Analysis**

37. Economic analysis was one of several instruments used in Project design. It helped determine the best way to meet the Project objectives and assessed each component independently to ensure that all had a net positive impact; the results were subject to risk and sensitivity analyses to verify their robustness.

38. The overall analysis and results derived from two studies, with additional analysis by ACUACAR and Bank staff. First, as part of the FS carried out by Hazen and Sawyer, a detailed alternative analysis of the disposal system and the respective treatment option was conducted. The alternatives were subjected to a least cost analysis taking into account economic, technical, environmental and social criteria. The analysis concluded that the discounted net present value of the selected alternative (which is a submarine outfall with preliminary treatment, with land conveyance and pumping station at Paraiso) was about USD50 million less than the next best alternative, land application (reuse for

irrigation with preliminary treatment, plus marine outfall for use when irrigation is not occurring), and about USD65 million less than the alternative of oxidation lagoons (which achieves secondary treatment of the wastewater flow in oxidation lagoons and subsequent discharge of the effluent to the Caribbean Sea through a marine outfall). Second, the wastewater disposal solution identified in the FS and the proposed design for other Project components were then subject to detailed economic and financial analyses conducted by a specialized consulting firm (Soluciones Integrales), ACUACAR and Bank staff.

39. These analyses aimed to improve Project design. They were used to prioritize investments to be financed by the Bank, ensure a minimum net positive impact and eliminate investments for which the estimated return was below the 12 percent economic cut-off rate. The analyses included a discussion of non-monetary benefits, considered the Project from the financial, economic and distributional aspects, assessed the poverty impacts and externalities and included sensitivity and risk analyses. The analyses concluded that the Project would provide substantial benefits to the District of Cartagena and to the overall Colombian economy, with a net present value of over USD8 million at the time of appraisal and an internal rate of return of 16 percent. The sensitivity and risk analyses confirmed that these results were robust. See also Annex 1, Item 24.

40. The studies yielded a conservative estimate of results, in line with best practice. The analyses quantified only those benefits associated with elimination of rationing and intermittent supply, and increases in service coverage for the case of water. Willingness to pay (WTP) for improved hygienic and environmental conditions resulting from sewage collection and treatment was estimated using a contingent valuation method. Tourism benefits were noted in the PAD. Given that the Project was already yielding a positive net present value, a conservative approach was used and the economic benefits associated with tourism, which are largely indirect and subject to significant uncertainty, were not quantified for use in the analysis. For further discussion of this issue, see Annex 1, Item 23.

41. Capturing the richness of this analysis and its impact on Project design in the PAD posed a challenge for the Bank team. The analysis was thorough and was effectively used to select the most appropriate investment alternative to reach the Project objectives. It relied on extensive and lengthy studies; the analysis in the FS and the study prepared by Soluciones Integrales total over 200 pages. Background studies in many areas of Project preparation, from environmental assessment to financial management, were similarly voluminous. In the interests of brevity, the presentation in the PAD summarized the analysis and results, and in doing so did not present fully the analysis undertaken.

### **Project Management Structure and Financial Sustainability**

42. Similar to the efforts undertaken to select the best technical solution to the District's wastewater problems, the Bank team assessed and designed what has proven to be an effective institutional and financial structure for the Project. The District of Cartagena is the Borrower for the Bank Loan financing the Project, with the Government



of Colombia providing a guarantee. The authorities and Bank staff were well aware of the District's financial performance, including the need for strengthened financial systems and improved collection performance of the District's unified property tax (Impuesto Predial Unificado, or IPU). As such, the Bank carried out due diligence during Project preparation and appraisal to ensure the financial management and audit arrangements of the Project would be consistent with Bank procedures and practice.

43. The earlier decision to create ACUACAR as a mixed capital company with greater independence from the District's overall operations and finances – implemented with Bank assistance to the sector – in part reflected this concern over the District's finances. The detailed assessment and financial projections of the District, including risk analyses, were carried out during Project preparation. The main conclusion of the assessment was that the Project and associated Loan needed to be reduced in size to be compatible with a sustainable financial position of the District's finances. Like other cities in Colombia, Cartagena relies on large and predictable transfers from the national government as part of a revenue sharing fiscal system. The Bank's analysis focused on two important financial issues: the District's ability to provide the agreed share of counterpart funding in a timely way to carry out the works as planned, and later its financial ability to meet its share of the debt service associated with the Bank Loan.

44. To ensure the Project's viability, the source of funds for counterpart financing and loan repayment was designed to come from three streams: (i) national transfers; (ii) royalty funds; and (iii) IPU. Funds were to flow to a Trust Fund administered by an acceptable financial entity, in this case, La Previsora, which was already handling many other government programs and financing mechanisms. The first two sources of funds had a record of being stable and predictable and formed a large part of the funds required. The funds from the IPU were set at 18 percent of total collections. The risks of funding shortfalls from the IPU were judged to be low since the IPU's share of the Project's financing accounted for only 3 percent of the District's overall income.

45. By making ACUACAR an independent utility with private sector capital, ownership and management, and through the design of the flow of funds to the Project from different sources, the Bank's standards for appropriate due diligence were met. Dealing with Cartagena's overall financial framework and performance was not fundamental to achieving the objectives of this infrastructure project. For a municipal management loan, however, improving the District's finances could be an important objective.

46. The positive actual results in the financial management and status of the Project (more than adequate capitalization of the Trust Fund, and adequate reporting) confirm the Bank's judgment and approach. As part of Project supervision, the Bank has engaged an expert to review the financial position of the District and IPU performance on an annual basis. While IPU revenues were initially less than had been expected at appraisal, the strengthening of the value of the Colombian peso resulted in an increase in dollar terms of the funds deposited to the Trust Fund. The last two annual reviews by a Bank consultant concluded that the Trust Fund was overcapitalized, and suggested a reduction in the level of contribution. Using a conservative approach, the Bank did not act upon this

recommendation, since the Project's final costs were not yet known. Moreover, in 2004, the District made major progress on collecting arrears of the IPU, consequently reducing its other, non-Bank debt to nearly zero and further strengthening its financial position. Counterpart funds have already been fully provided by ACUACAR and the District, and the Government of Colombia has provided more than 90 percent of its share. This is a considerable achievement, since the Bank Loan is less than half disbursed. Additional information is provided in Annex 1.

### **Summary**

47. The selected disposal alternative provides significant benefits of improved sanitation to a city of one million people who are mostly poor and currently suffer from unacceptable sanitation conditions. The disposal of the wastewater via the submarine outfall offshore of Punta Canoa was found to be the most cost-effective solution to Cartagena's wastewater problems. Environmental and social analyses demonstrated that this alternative could be achieved without significant adverse effects on the environment or the affected population. In sum, it is Management's view that the Project's technical, economic, financial, environmental and social analyses have demonstrated that the Project will achieve significant public benefits with a high rate of return, without significant environmental or social risks and in a fiscally sustainable manner.

### **V. MANAGEMENT'S ACTION PLAN**

48. Management appreciates the Panel's findings of broad concurrence with Bank policy in key areas such as coverage of alternatives analyzed, the use of a POE, the monitoring program, consultation with the people of Cartagena, and indigenous peoples. Management also welcomes the Panel's observations on specific areas for further strengthening the Project. The following table presents the action plan following up on the Panel's findings.

<b>Management Action Plan</b>	
<b>ISSUE/FINDING</b>	<b>PROPOSED ACTION</b>
<b>OD 4.01 – Environmental Assessment</b>	
<b>Proposed Design of the Submarine Outfall</b>	In view of the concerns expressed by the Panel, the Bank has requested the expert who prepared the second two-dimensional validation model to re-run the model and incorporate the influence of wind patterns. The Bank will also request that ACUACAR hire an international expert to provide a third and independent opinion on the two-dimensional models contracted under the Project and the detailed review presented in Annex B of the Panel's report.
<b>Risk of Diapirism (mud volcanism)</b>	In response to the Panel's suggestion and given the utility and relatively low cost of such a survey, Management has recommended that ACUACAR undertake a side scan sonar survey. ACUACAR plans to carry out the survey by December 31, 2005.
<b>Overland Pipeline Design</b>	Given the importance of an emergency plan and concerns expressed in the Request, Management will request ACUACAR to more fully articulate and communicate the emergency plan and related risk mitigation measures to concerned parties. Management will request that the updated plan be available for public consultation by March 2006. For information on other aspects of public consultation, see Item 14 in Annex 1 of this response.
<b>Disposal of Solids</b>	In response to the Panel's finding, ACUACAR will carry out an analysis of alternative disposal methods for the screened material. ACUACAR plans to submit the completed analysis to the Bank by December 31, 2005.
<b>Project Impacts on Locally Affected Communities – Fishing</b>	To respond to the community's concerns, ACUACAR, as part of the original Project, has agreed to support a program to strengthen fishing activities, based on a study it is currently undertaking (planned completion date of September 2005), which draws on the 2003 INVEMAR study financed by the Project. ACUACAR is working with the communities to identify specific activities for optimized fishing opportunities in Punta Canoa. This work will be monitored during Project supervision.
<b>Social Impact Assessment and Benefits for Afro-Colombian Communities in the North Zone</b>	The piped water, under construction, is planned to be delivered to the North Zone communities prior to or during the last quarter of 2005. These investments were originally to be financed by the District, according to the Loan Agreement. Due to Project cost savings, these investments will now be financed by the Loan, freeing up municipal budget for other uses. Moreover, as part of the Project, in-house sanitation is under construction in La Boquilla and Manzanillo del Mar, and under bidding for Punta Canoa, where delivery is projected for April 2006. La Boquilla has already been connected to the sewer network. ACUACAR has committed to extend the network to Punta Canoa, Manzanillo del Mar and Arroyo de Piedra in the next 24 months, in parallel with the construction of the outfall. Punta Canoa has confirmed its interest in a Community Center, which is planned to be provided by April 2006. A plant nursery has been established in Punta Canoa, to be managed cooperatively by the community, to create jobs and supply trees to the Project. Supervision will focus on the early delivery of the benefits under the social program.
<b>Consultations and Communication Strategy</b>	Management will review the quality of the outreach strategy and activities with ACUACAR, and work with it to support the maintenance of the outreach program to the end of the Project, and to extend the communications program to Arroyo de Piedra. The program will draw on the findings of the recently issued final report of Fundación Vida Caribe on the Social Impact Mitigation and Community Development Program, which identifies training and information proposals of interest to community residents.

<b>OP 10.04 – Economic Evaluation of Investment Operations</b>	
<b>Economic Evaluation of Alternatives</b>	Management will update the results of the economic analysis to take into account the additional investments required by the environmental license that would need to be operational in 2015, and adjust land values.
<b>OD 4.15 Poverty Reduction</b>	
<b>Poverty Reduction</b>	Pertinent actions are covered above under Project Impacts on Locally Affected Communities – Fishing and Social Impact Assessment and Benefits for Afro-Colombian Communities in the North Zone.
<b>OP/BP 10.02 – Financial Management</b>	
<b>Financial Management Assessment and Capacity of the District of Cartagena</b>	Noting that it is a common practice, when working with financial agents, to review audited financial information as part of supervision activities, and since the Trust Fund account is reviewed as part of the scope of work performed by the Trust Fund Manager's auditor, the Bank will obtain and put on file annual audit reports of La Previsora (the Trust Fund administrator).
<b>OTHER</b>	
<b>International Agreements</b>	CARDIQUE, the regional environmental authority, is responsible to monitor the conditions and the obligations of the environmental license that it has granted to ACUACAR. As part of its routine supervision, the Bank will confirm that ACUACAR is fulfilling conditions of the license.

## VI. CONCLUSION

49. In Management's view, the Bank has made every effort to apply its policies and procedures and to pursue its mission statement in the context of the Project. It is Management's judgment that the proposed Action Plan appropriately addresses the issues identified in the Panel's report.

**MANAGEMENT REPORT AND RECOMMENDATION  
IN RESPONSE TO THE INSPECTION PANEL INVESTIGATION REPORT ON  
COLOMBIA –CARTAGENA WATER SUPPLY, SEWERAGE AND  
ENVIRONMENTAL MANAGEMENT PROJECT**

**ANNEX 1**

**FINDINGS, COMMENTS AND ACTIONS**

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
<b>OD 4.01 – Environmental Assessment</b>			
1.	<p><b>Environmental Assessment: Project Screening</b> Environmental screening was appropriate and in compliance with OD 4.01.</p>	58	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
2.	<p><b>Stage in Project Cycle</b> EA for the Project was initiated early in the Project cycle, and in this respect complied with OD 4.01.</p>	59	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
3.	<p><b>Analysis of Alternatives and Use of Panel of Experts</b> Study of alternatives covered most of the alternatives for this type of Project and evaluated basic parameters. In this respect, the Bank complies with OD 4.01, paragraph 4 and Annex B (f).</p> <p>The Panel is concerned about diligence with which alternatives other than the preferred alternative of submarine outfall were studied. The voluminous FS and EA, which closely follows the FS, give greater attention to submarine outfall and do not demonstrate systematic comparative study of all alternatives as required by OD 4.01.</p> <p>The Panel finds that the appointment of a panel of experts to review the technical work in the feasibility study and the design of the Project is consistent with Bank policies, particularly OD 4.01, but is not convinced that there was a sufficiently thorough analysis of alternatives before a decision was made.</p>	76-77	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel concerning the scope of alternatives and the appointment of a POE.</p> <p>Regarding the extent of comparative analysis of alternatives, Management views the approach followed as consistent with standard practice for a feasibility-level study. The purpose of the analysis of alternatives was to determine the least cost environmentally appropriate solution to achieve the Project objectives. Principal objectives of the Project were to improve the water and sewer services in Cartagena and the sanitary conditions of the city's poorest population and facilitate the environmental cleanup of water bodies surrounding the city (Cartagena Bay, Caribbean beaches, and Ciénaga de la Virgen). Realization of the wastewater collection treatment and disposal system under the Project would significantly improve the environmental health conditions for all of Cartagena's population, of which about 85 percent are poor. For many of the poor neighborhoods surrounding the Ciénaga, the Project would improve unacceptable sanitary conditions, since raw wastewater generated in these neighborhoods and in other parts of the city flows in open storm water drainage canals through the area.</p> <p>As cited in the Panel's report, the FS identified and analyzed a comprehensive set of alternatives. The main alternatives for final disposal of domestic sewage were: (i) Cartagena Bay; (ii) Ciénaga de La Virgen Lagoon; (iii) the Caribbean Sea; and (iv) reuse for irrigation. The study also considered five treatment options, four sites for a marine outfall, four outfall pipe diameters, five types of pipe material, nine land conveyance routes in four corridors, and four different diffuser depths. Overall, fifteen alternatives combining different treatment levels and final disposal sites were considered. All alternatives were evaluated from technical, economic, environmental and social perspectives. Effluent quality, initial investment costs, operation and maintenance costs, and land uptake were the main comparison criteria. Additional environmental and social criteria were used as well. As a result of this analysis, the preferred alternative was selected and in-depth analysis of this alternative was conducted subsequently.</p> <p>Coastal cities have three options for wastewater disposal: (i) to the sea; (ii) effluent reuse; and (iii) injection by deep wells to saline</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
			<p>aquifers. Option (ii) is rarely used and requires reuse conditions that do not exist in Cartagena (see below). Option (iii) also is rare and depends on hydrogeological conditions, which do not exist in Cartagena.</p> <p>In the early 1990s, the proposed wastewater management scheme for Cartagena entailed treatment of wastewater in oxidation lagoons and discharge of the effluent into the Ciénaga (from which it would eventually reach the sea). This was not considered an appropriate long-term solution for Cartagena for several reasons. Effluent discharge to the Ciénaga would cause eutrophication of its water and damage to the mangroves growing around it (tertiary treatment would be needed to prevent eutrophication). Wastewater treatment in oxidation lagoons is difficult to control if the biological process collapses or the lagoons become overloaded; large oxidation lagoons such as those proposed for Cartagena could become a problem for a large tourism and resort city. A lagoon scheme would also have substantial land requirements. Finally, the cost of treating Cartagena's wastewater in oxidation lagoons and discharging the effluent to the Ciénaga was found to be higher than the cost of the selected alternative.</p> <p>The Panel stated (para 75) that “only cursory consideration [was given] to the option of constructing a sewage treatment plant near Cartagena, with waters going to a marine area or alternatively reused for agriculture as a supplement to the recommended disposal system.” This alternative was considered appropriately. However, the option of sending treated wastewater (effluent) to the marine environment—regardless of whether the treatment is preliminary, primary secondary, or in a lagoon—would have required disposal through a submarine outfall equal in length to that of the proposed Project, if located offshore of Punta Canoa, or much longer if located at any point closer to Cartagena, since the sea bed slope slopes away most steeply from Punta Canoa. A tertiary treatment plant might have required a shorter outfall but would have been the most expensive alternative while generating no incremental benefits.</p> <p>The second option, a sewage treatment plant with treated effluent reused for agriculture, was determined not to be viable due to: (i) no demand for irrigation water in the area; (ii) the additional costs in treatment, irrigation and agriculture infrastructure that a reuse project would require; (iii) the availability of abundant fresh water for irrigation from Canal del Dique at a lower cost; and (iv) lack of an institutional framework capable of handling such a system. Furthermore, any wastewater reuse scheme would have needed to be coupled with installation of alternative discharge of the wastewater during the seasons that irrigation is not required as well as in emergency situations. A submarine outfall can also serve as an alternative discharge option, so the Project does not exclude future partial or total reuse of wastewater. The conveyance and submarine outfall system could support such an initiative in the future.</p> <p>The composition of the POE changed over time. For the first two meetings, when the task was to review the alternatives proposed by Hazen and Sawyer, most of the POE members were specialists in wastewater treatment, although submarine outfall specialists were also included, since that option was also available. Once the proposed alternative (preliminary treatment followed by an effective submarine outfall) was selected, the majority of the experts invited to participate in the POE were submarine outfall specialists, since this was the more complex aspect of the proposed alternative.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
			<p>Management's view is that the members of the POE comprised a valuable mix of expertise.</p> <p>In Management's judgment, the analysis undertaken was reasonable and was sufficient to select a preferred alternative. Additional analysis of alternatives is unlikely to have resulted in a different preferred alternative.</p> <p><b>Action:</b> No further action required.</p>
4.	<p><b>Selected Option: Submarine Outfall</b>                      Disposal of sewage to sea via a submarine outfall is tried and proven technology which, under suitable conditions, offers low-cost low-maintenance solution for acceptable disposal of human wastes.</p> <p>The Panel observes that the FS and EA did not address the possible long term environmental and health effects on the coastal and marine environment if there were to be multiple outfalls in the area and volume of sewage and organic wastes increased significantly so as to exceed the absorptive capacity of the marine area. This is an issue that may need to be addressed in future.</p>	78-79	<p><b>Comment:</b> Management acknowledges the Panel's finding that outfalls are tried and proven technology for acceptable disposal of human waste.</p> <p>Management agrees that, in general, cumulative environmental and health impacts of all future investments in wastewater disposal should be evaluated. However, for the City of Cartagena, there is no expectation of additional outfalls within the time horizon of the Wastewater Master Plan up to the year 2025. Nor is any information available concerning plans or locations for additional outfalls in the Cartagena region in the longer term. As a result, the assessment of this Project did not include the effect of multiple outfalls. The environmental assessment of any future project with an outfall, however, should examine the cumulative effects of such a proposed project with what would then be an existing outfall at Punta Canoa.</p> <p>As with the present Project, any future wastewater investment will be subject to the full environmental impact review required under Colombian legislation.</p> <p><b>Action:</b> No further action required.</p>
5.	<p><b>Punta Canoa as the Location for the Outfall</b>                      In terms of assimilative capacity, the Panel notes that Punta Canoa coastal waters could be a suitable site for an outfall if necessary precautionary measures are taken in design to ensure proper dilution of effluent so that nutrients are at an acceptable level, and to ensure decay of pathogens to a level safe for human contact.</p>	92	<p><b>Comment:</b> Management shares the Panel's conclusion on the suitability of the outfall site. With regard to pathogens, the system is designed to allow pathogen decay to a level safe for human contact and to meet the bathing water standards of the California Ocean Plan, which have been widely adopted around the world,<sup>3</sup> as well as those of Colombia, and new WHO standards at the shoreline. For further information on how outfalls work, see Annex 2. The assumption that nutrients must be immediately reduced to background levels is neither a usual assumption nor a usual design criterion (see Annex 3).</p> <p>Mitigation measures have been built into the Project to manage situations where the expected pathogen levels might not be achieved. In such a case, the effluent in the treatment plant would be chlorinated to ensure overall reduction of pathogens (disinfection plus decay in the marine environment) to a level safe for human contact. Although the probability that such treatment would be needed is low, a chlorination option has been incorporated into the treatment plant.</p> <p><b>Action:</b> No action required.</p>

<sup>3</sup> Total level of coliforms not exceeding 1000 MPN per 100 ml, provided that not more than 20 percent of the samples at any sampling station, in any 30 day period, may exceed 1000 per 100 ml and provided further that no single sample, when verified by a repeat sample taken within 48 hours, shall exceed 10,000 per 100 ml. These standards must be met at a distance of 1000 feet from the shoreline or the 30 foot depth contour, whichever is farthest offshore.

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
6.	<p><b>Proposed Design of the Submarine Outfall</b></p> <p>The Panel is aware that no consensus exists as to whether the risk is high or low that disposal of the effluent under current outfall design will not be safe. Bank Management relied on a robust two dimensional model to assess risk of contamination near shore from the outfall, and used field data taken over an extended period of time. While necessary ocean modelling studies were conducted, the methodology used did not capture the possibly important influence of wind on near surface currents in a stratified water column. This influence could affect assessments of the dilution of effluent and the risks of contamination to marine and coastal environments.</p> <p>The Panel finds that if a three-dimensional model, rather than two dimensional, were used to assess risk, the diffusion patterns and estimates of shoreline concentrations might be different and that greater certainty regarding the risk could be secured. The results could affect the distance from the shore and the depth required for safe disposal of Cartagena wastes.</p> <p>The Panel notes that after a first bidding process that resulted in costs much higher than those estimated in the PAD and the Engineer's cost estimate, new specifications are being prepared calling for the use of High Density Polyethylene (HDPE) for the construction of the outfall. According to Management, this alternative should result in lower costs because, unlike reinforced concrete pipes, HDPE pipes would not have to be trenched in the bottom of the sea over all its length but only in the surf zone. Analysis of the original bids showed that the cost of trenching was very high and now should be partially saved.</p>	107-109	<p><b>Comment:</b> Management acknowledges the comments and suggestions of the Panel regarding the modeling of the outfall design. In Management's view, the methodology to design the outfall took the relevant factors into account, as explained below.</p> <p>Two distinct two-dimensional models were used during Project preparation and subsequently during detailed design. The first, by the project consulting firm Hazen and Sawyer (1998), took into account the influence of wind and the characteristics of the water column. The second (2003), by an independent expert (see Annex 3 of Management's Eligibility Response), was prepared to review the validity of the Hazen and Sawyer design, which it confirmed. Models of this type are extremely complex due to the multiplicity of variables. The second study omitted consideration of the wind effect. This does not seem to detract from the validity of the model as the results of both models did not differ significantly. For further information, see Annex 3 of this response.</p> <p>Management notes that a three-dimensional model is not necessarily more conservative or accurate. To provide reliable results, such a model requires significantly more data. From the time of Project preparation to date, most projects for outfalls discharging at depths similar to those proposed for Cartagena have been designed with two-dimensional models. In contrast, three-dimensional models are commonly used for large outfall projects discharging to deeper water than the current Project. Thus, it is Management's view that running a three-dimensional model would have no significant value added, and any benefits would likely be outweighed by the cost and time required.</p> <p>Management acknowledges the Panel's observation on the cost savings through use of HDPE pipes. The bidding process will not begin until September. The choice of pipe material will be an outcome of the lowest cost responsive bid.</p> <p><b>Action:</b> In view of the concerns expressed by the Panel, the Bank has requested the expert who prepared the second two-dimensional validation model to re-run the model and incorporate the influence of wind patterns. The Bank will also request that ACUACAR hire an international expert to provide a third and independent opinion on the two-dimensional models contracted under the Project and the detailed review presented in Annex B of the Panel's report.</p>
7.	<p><b>Risk of Diapirism (mud volcanism)</b></p> <p>The Panel finds that the potential for the pipeline to be ruptured or otherwise significantly disturbed by diapirism appears to be low. Since the study cited by Bank found diapirism about 300 meters from the outfall and eyewitness accounts cite diapirism off Punta Canoa in 1979, the Panel notes that it may be useful to have side scan sonar survey of the proposed outfall trajectory to map subsurface soil structure to a depth of low frequency sonar penetration to reduce any remaining</p>	120-124	<p><b>Comment:</b> Management acknowledges the Panel's finding that the risk of diapirism is low. Management's view is that these findings were adequately confirmed by the FS, EA and subsequent analysis by Vernetite (March 2001). This view is shared by CARDIQUE and the Colombian Ministry of the Environment.</p> <p><b>Action:</b> In response to the Panel's suggestion and given the utility and relatively low cost of such a survey, Management has recommended that ACUACAR undertake a side scan sonar survey. ACUACAR plans to carry out the survey by December 31, 2005.</p>



No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	uncertainty regarding the possibility of diapirism extending to the outfall, and to publish the results.		
8.	<p><b>The Land Conveyance System (Routing, Pumping Stations and Treatment Plant Locations)</b></p> <p>For the selected option of a submarine outfall, the analysis of alternatives for land conveyance systems, liquid disposal locations and pipeline corridors, in terms of their potential health and environmental impacts, meets the OD 4.01 requirement that alternatives be considered. Bank staff exercised due diligence in considering alternatives and mitigation measures and complied with OD 4.01 on EA.</p>	132	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
9.	<p><b>Overland Pipeline Design</b></p> <p>The Panel finds that this Issue [of contamination of surface and groundwater resources] was neither analyzed in the 1999 EA nor included in the Environment Management Plan. The Panel finds that groundwater monitoring is important in order to identify leakage and actions to mitigate it.</p> <p>After reviewing contingency manual, the Panel remains concerned about the adequacy of the planning for emergencies [such as risk of rupture or disruption of electrical service]. Records examined do not clarify whether Paraíso pumping station system provides for storage area in case of emergencies.</p>	135-137	<p><b>Comment:</b> Management concurs with the Panel that adequate risk mitigation measures are important to have in place. State-of-the-art stand-by pumps and generators will serve to minimize any risk of electrical failure. The risk of pipe rupture, while low, could not be mitigated by storage, given the maximum expected flow (up to 300,000 cubic meters per day by 2025) and the reasonable time required to repair breakage. In case of rupture, the existing emergency plan provides that the wastewater be diverted to the Ciénaga. The Government of Colombia has implemented the La Bocana Project (a Dutch financed project totaling USD24 million), a series of floodgates to mitigate the impact of such diversions by allowing dilution of wastewater in the Ciénaga with sea water.</p> <p>Groundwater resources are scarce in the Cartagena region. No production wells exist in the area and groundwater is not a source of water supply. The probability of groundwater contamination from leaking wastewater is low and the practical impact is small due to lack of use of groundwater. The risk of contamination of surface water along the route of the pipe is nil, because there is no surface water in this area.</p> <p><b>Action:</b> Given the importance of an emergency plan and concerns expressed in the Request, Management will request ACUACAR to more fully articulate and communicate the emergency plan and related risk mitigation measures to concerned parties. Management will request that the updated plan be available for public consultation by March 2006. For information on other aspects of public consultation, see Item 14 in Annex 1 of this response.</p>
10.	<p><b>Disposal of Solids</b></p> <p>The Panel finds that the Project environmental studies did not consider alternatives for the disposal of solids recovered during preliminary treatment of the sewage stream. In this respect, Management does not comply with OD 4.01. Although Management now asserts that a plan exists for disposal of sludge, the Panel has not been able to find a consideration of alternatives for disposal of sludge as required before finalizing a plan.</p>	142	<p><b>Comment:</b> Management agrees that a study of alternatives for disposal of solids was not carried out, because of accepted practice for disposal of this type of material. The solids requiring disposal consist of materials accumulated as a result of screening, such as clothing, plastics, paper and the like. Accordingly, a technical analysis of disposal was undertaken. That study indicated that at the beginning of outfall operation, the quantities of compacted, dewatered material would amount to one truck load per day, increasing to a maximum of two truck loads per day after 20 years. These wastes could be deposited in a municipal sanitary landfill, specifically the La Paz landfill, located about 17 kilometers from the city.</p> <p><b>Action:</b> In response to the Panel's finding, ACUACAR will carry out an analysis of alternative disposal methods for the screened material.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
			ACUACAR plans to submit the completed analysis to the Bank by December 31, 2005.
11.	<p><b>The Monitoring Program</b> In requiring a monitoring plan with adequate baseline data, the Bank complied with provisions of OD 4.01. ACUACAR, as of summer 2003, had prepared baseline data regarding fisheries in the area. This complies with OD 4.01. It is essential that these studies be periodically updated to maintain their relevance and to identify changes in water quality or in fisheries.</p>	147	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel. The environmental license that was issued by CARDIQUE in 2001 legally binds ACUACAR to maintain its monitoring program and update its results regularly.</p> <p><b>Action:</b> No action required.</p>
12.	<p><b>Project Impacts on Locally Affected Communities - Fishing</b> The Panel finds that in Project preparation, Project's potential effects on fishing were not adequately addressed. The Panel examined Project records but found no adequate social evaluation and mitigation proposals of potential impacts on the local population's lives and livelihood. The Panel finds that this does not comply with OD 4.01.</p> <p>The Panel finds that the EA and Management erred in concluding that fishing in the area of influence of the outfall is negligible or unimportant in the affected communities without more detailed studies about this issue.</p>	152, 210	<p><b>Comment.</b> Management shares the Panel's concern regarding the livelihoods and well-being of the populations in the North Zone. Management also recognizes that fishing is important for many households in North Zone communities, despite low levels of income generated. For example, based upon the 2003 INVEMAR report, the annual total net income from fishing for Punta Canoa is about USD24,000 per year for 132 fishermen. It is Management's view, based on the data, that the Project's impact on fishing will be low, as indicated in the EA, for the technical reasons described below.</p> <p>The Summary Social Assessment (Annex 10 of the PAD) indicated the importance of fishing for Punta Canoa. Data from the SIA confirm this and note (page 22, Fig. 8) that one in four of Punta Canoa's population over 15 years of age was engaged in fishing at the time of the survey. Similarly, the SIA found that one in twelve adults in La Boquilla was engaged in fishing. Yet even recognizing the importance of fishing for livelihoods in the North Zone, (further confirmed by the in-depth 2003 study by INVEMAR, cited by the Panel), Management stands behind the EA's finding that "Impact on fisheries was also deemed of low magnitude and importance," for three reasons. First, the discharge from the outfall is in a location that is already degraded by the Rio Magdalena, and underwater surveys have found nearly non-existent biological activity. Thus, no hatcheries, spawning or feeding grounds that might be affected were found in the immediate vicinity of the outfall discharge. Second, risks to the marine environment beyond the immediate discharge area are negligible. Third, the fishing practices of the community, whether artisanal fishing close to shore or market-oriented fishing, using boats with outboard motors that travel several hours from Punta Canoa, are such that the fishers' livelihoods would not be affected by the location of the outfall.</p> <p><b>Action:</b> To respond to the community's concerns, ACUACAR, as part of the original Project, has agreed to support a program to strengthen fishing activities, based on a study it is currently undertaking (planned completion date of September 2005), which draws on the 2003 INVEMAR study financed by the Project. ACUACAR is working with the communities to identify specific activities for optimized fishing opportunities in Punta Canoa. This work will be monitored during Project supervision.</p>
13.	<p><b>Social Impact Assessment and Benefits for Afro-Colombian Communities in the North Zone.</b> The Panel finds that the full SIA does not adequately address compensation for the affected Afro-Colombian communities in</p>	205-206, 219, 223-225	<p><b>Comment.</b> Management views Project support to the North Zone communities as including them in the Project and ensuring that they share in Project benefits, rather than as compensating them for the existence of the Project. Project support is also targeted to ensure that any adverse risks they face under the Project are mitigated, in line with OD 4.01. The sharing of Project benefits includes but is not</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	<p>the North Zone for bearing most of the risk of negative impacts of the sewerage component for the Project.</p> <p>The Panel finds that the Social Impact Assessment (SIA) is unsatisfactory with respect to its analysis of the Project's impacts upon the communities living in the North Zone of Cartagena who presented the Request for Inspection. Irrespective of whether Afro-Colombians are classified as indigenous peoples or not, they are affected by the Project because they will be exposed to a wide range of risks as a result of the construction and operation of the Project.</p> <p>The Panel notes that the piped water is expected to be safer and less expensive than the trucked water, which will be a significant benefit for the community. The Panel finds that this is in compliance with OD 4.01.</p> <p>The Panel notes that these communities may be exposed to significant risks under the Project. Some compensation for the potential impacts is provided under the Project, e.g., water and sanitation services, in accord with OD 4.01.</p> <p>The Panel welcomes the initiative to provide compensation for the Afro-Colombian minorities, but finds that details about some of the compensation measures are not specific, and it is unclear whether appropriate financial arrangements have been made to implement benefits, such as sanitation services and maintenance and operation of community centers. The Panel also finds that implementation of these measures seems to be lagging behind.</p> <p>The Panel also finds that information about these compensatory measures has been inadequately disseminated to the villages.</p> <p>The Panel welcomes the proposed benefits for the people living in the Project area but notes that there seems to be no direct relation between such benefits and the risks that people may be exposed to as a consequence of Project construction and operation...In this sense, the proposed Social Impact Mitigation and Community Development Program seems to fall short in addressing the mitigation or compensation for harm related to potential adverse impacts of the Project as required by OD 4.01.</p>		<p>limited to piped water and sanitation services to various North Zone communities to improve their well-being.</p> <p>In order to develop risk mitigation measures, the SIA was led by an anthropological expert with strong local knowledge, under the supervision of Bank social scientist staff, and extensive consultations were held with Project communities to identify potential risks. The communities' most commonly expressed concerns were capacity to pay for services, increases in taxes and land prices, and loss of eligibility for subsidies, as well as construction nuisances, risk of damage to the pipeline, fishing impacts, and foul odors. Certain risks, for example, land price increases and the risk of displacement by urban growth, reflect long-term trends, subsequent to the construction of the Cartagena-Barranquilla highway, and go beyond the scope of the Project. Nonetheless, the Social Impact Mitigation and Community Development Program aims to address these risks by supporting the strengthening of community organizations and ensuring their linkage to and participation in the District's Urban Rehabilitation Program.</p> <p>Specific risks such as construction nuisances are being addressed along lines indicated in the Panel's report, e.g., via blacktopping a road through Punta Canoa (completed recently), and by building guidelines into construction bidding document specifications to minimize construction impacts. Oversight is provided by social and environmental experts attached to ACUACAR, and communities will be advised ahead of time regarding construction plans. Similarly, foul odors are being mitigated in the design of the wastewater treatment plant and via the burial of the pipeline underground. Regarding fishing impacts, see Item 12.</p> <p>Management concurs with the Panel's finding that the Social Impact Mitigation and Community Development Program has fallen behind schedule, as has the overall Project, thus delaying important benefits to the community. Implementation has accelerated recently, however, and key services are expected to be delivered shortly. See Item 14 concerning dissemination of information.</p> <p><b>Action:</b> The piped water, under construction, is planned to be delivered to the North Zone communities prior to or during the last quarter of 2005. These investments were originally to be financed by the District, according to the Loan Agreement. Due to Project cost savings, these investments will now be financed by the Loan, freeing up municipal budget for other uses. Moreover, as part of the Project, in-house sanitation is under construction in La Boquilla and Manzanillo del Mar, and under bidding for Punta Canoa, where delivery is projected for April 2006. La Boquilla has already been connected to the sewer network. ACUACAR has committed to extend the network to Punta Canoa, Manzanillo del Mar and Arroyo de Piedra in the next 24 months, in parallel with construction of the outfall. Punta Canoa has confirmed its interest in a Community Center, which is planned to be provided by April 2006. A plant nursery has been established in Punta Canoa, to be managed cooperatively by the community, to create jobs and supply trees to the Project. Supervision will focus on the early delivery of the benefits under the social program.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
14.	<p><b>Consultations and Communication Strategy</b></p> <p>The Panel finds that during Project preparation there were extensive consultation efforts with people in Cartagena. This accords with OD 4.01. However, OD 4.01 requires that there be extensive consultations with all affected people and that these consultations be timely, meaningful and relevant to Project design and execution. This is particularly important in the case of affected Afro-Colombian communities living in the area of the proposed outfall, who state they were not consulted about the location of the outfall but rather only informed about its construction and operation.</p> <p>Commendably, ACUACAR arranged for a cross-section of society to inspect existing outfalls, similar to the proposed one for Punta Canoa. Representatives from all three affected villages visited outfalls in Valparaiso, Chile and in Montevideo. The Panel finds that this is best practice. Unfortunately, this visit took place after the Project had been designed and its location determined, while OD 4.01 requires interaction during preparation of Project.</p> <p>The Vida Foundation communications program was started over one year ago for Punta Canoa and Manzanillo del Mar. The Panel found that Arroyo de Piedra is excluded from this program. Starting a communications strategy for the affected communities five years after appraisal is more expensive and less effective than starting it during Project preparation.</p> <p>While the Project commendably included a communications strategy, it failed to reach most members of the affected communities in the North Zone. An outreach strategy was added too late to deal effectively with Project-related trauma and stress in these communities. The Panel finds that consultations and communications with the affected Afro-Colombian communities in the area of the submarine outfall did not comply with OD 4.01.</p>	233-242	<p><b>Comment:</b> Management acknowledges the Panel's finding that there were extensive consultation efforts with people in Cartagena. While not every resident of the North Zone may have been reached, an unusually intensive effort was made to reach representatives and residents of these communities. The Project has implemented a wide-ranging, long-term consultation and communication approach from the outset, designed to reach a broad range of stakeholders. The first stages in February 1998 essentially involved stakeholder workshops to discuss initial Project designs with representatives of Project-affected communities and with private and public officials. Final Project designs were then discussed in stakeholder workshops in February 1999.</p> <p>The workshops in 1998-1999 with stakeholders covered the Terms of Reference for the EA, the various technical options (outfall versus non-outfall options and potential outfall locations), the technical, economic and social information that strongly pointed towards the outfall as being the best alternative in terms of maximizing net benefits at minimum risk, as well as the proposed environmental and social impact mitigation programs and monitoring processes. The SIA prepared by August 1998 used stratified sampling that focused on the two areas most likely to be affected by the Project, namely urban Southeast Cartagena and rural communities in the North Zone. These consultations led to the extension of Project benefits to the North Zone and to a range of risk mitigation measures under the environmental and social components to address concerns identified by the communities. EA consultations comprised circa 250 events between 1998 and 2003. Moreover, while site visits came later in the process, Management acknowledges the Panel's finding that these visits organized by ACUACAR were best practice, and views these as an important additional component of the first phase of the outreach program.</p> <p>After the environmental license was issued, media attention focused on the Project. At the same time, the Project was experiencing delays in extending water and sanitation benefits to the North Zone. This led to a second phase of communications and consultations after 2001, in which a communication strategy was designed to inform a broader audience in Cartagena, while efforts were also redoubled in the North Zone through community information centers, social events, comics, posters and radio communications. Arroyo de Piedra was not included because technical work had determined by then that the risk of impact to the community, given its distance from the outfall, was minimal, although its beaches would continue to be monitored as part of the overall monitoring program.</p> <p><b>Action:</b> Management will review the quality of the outreach strategy and activities with ACUACAR, and work with it to support the maintenance of the outreach program to the end of the Project, and to extend the communications program to Arroyo de Piedra. The program will draw on the findings of the recently issued final report of Fundación Vida Caribe on the Social Impact Mitigation and Community Development Program, which identifies training and information proposals of interest to community residents.</p>
15.	<p><b>Consultations and Willingness to Pay Surveys</b></p> <p>Connection to the water and sewerage network is of utmost importance for North Zone communities. However, the Panel did</p>	248	<p><b>Comment:</b> In Management's view, the contingent valuation method was a useful tool to assess the economic benefits of the proposed interventions. The application of this method requires conducting surveys of a random sample of potential beneficiaries to elicit their demand for services and willingness to pay (WTP or gross</p>

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	<p>not find any evidence that a formal consultation process on all aspects of water and sewerage issues took place with the community of Punta Canoa. The Panel finds that willingness to pay surveys did not include Punta Canoa (or Manzanillo) and these communities were not adequately consulted on issues of willingness to pay and water tariffs.</p>		<p>associated benefit) for the goods or services to be provided by the Project. WTP surveys were conducted as part of the economic analysis and not as a consultation with communities. The original Project design did not include water and sanitation investments in Punta Canoa, Manzanillo del Mar; or Arroyo de Piedra; instead, these investments were the responsibility of the District of Cartagena, outside the Project scope. As such, the costs of these investments were not considered in the analysis and thus WTP surveys were not undertaken for them.</p> <p>In terms of the Panel's concern about additional consultations on the issues of WTP and water tariffs, it is Management's judgment that such additional consultations were not needed. The reason is that poor families unconnected to water were paying for 1 cubic meter of trucked water the equivalent to what these families (in stratum 1, the poorest in the system) would pay to ACUACAR for a monthly bill of up to 20 cubic meters of potable water, plus the convenience of a household connection. The quantity of the subsidized consumption is considered more than adequate to satisfy the monthly needs of a typical family.</p> <p><b>Action:</b> No action required.</p>
<b>OP 4.04 – Natural Habitats</b>			
16.	<p><b>Natural Habitats</b> The Panel finds that the mangrove swamps of the Ciénaga and Bahía de Cartagena and the coral reefs in the Caribbean Sea have been fully considered in the Feasibility Studies and the Environmental Assessments. Although item (ii) of Project component G on Restoration and Conservation of the Ciénaga de la Virgen Natural Reserve has yet to be implemented (because the Project has not yet advanced to a stage where this is applicable), the Bank has otherwise complied with OP 4.04.</p>	162	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
<b>OP 4.07 – Water Resources Management</b>			
17.	<p><b>Water Resources Management</b> The Bank complied with OP 4.07 on Water Resources Management and with OD 4.01 which requires that “water resources management should be environmentally sustainable”.</p> <p>The decision to disregard Ciénaga de la Virgen as a potential place for final disposal of waste after treatment allows for preservation of this important ecosystem. The FS, EA and supplementary studies document well and analyze the condition of the biophysical environment, particularly of the Caribbean Sea, Bahía de Cartagena and Ciénaga de la Virgen. However, they do not consider terrestrial environment in as great a depth.</p>	164-166	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
<b>International Agreements</b>			
18.	<p><b>International Agreements.</b> The Panel notes that the license granted by CARDIQUE states that the Project shall adjust its treatment system to all requirements for the protection of water bodies and submarine ecosystems resulting from national legislation or international agreements to which Colombia will become a party.</p>	177	<p><b>Comment:</b> Management acknowledges the Panel's note. As also noted by the Panel, the 1999 Protocol to the 1983 Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena Convention) Concerning Pollution from Land-Based Sources and Activities has not entered into force, having been ratified by only two of the nine countries necessary to do so.</p> <p><b>Action:</b> CARDIQUE, the regional environmental authority, is responsible to monitor the conditions and the obligations of the environmental license that it has granted to ACUACAR. As part of its routine supervision, the Bank will confirm that ACUACAR is fulfilling conditions of the license.</p>
<b>OD 4.20 – Indigenous Peoples</b>			
19.	<p><b>Indigenous Peoples</b> The Panel finds that in the case of the Afro-Colombians who submitted the Request, the affected community meets most of the OD's criteria, except for "an indigenous language," and arguably a predominant "primarily subsistence-oriented production." The Panel finds that Afro-Colombians could reasonably have been regarded as indigenous peoples under Bank policies. But because of the absence of two of the policy criteria, the failure to do so in this specific case may not be deemed as noncompliance with the "judgment" called for in OD 4.20, para 5. If the Afro-Colombians were regarded as indigenous people, the provisions of OD 4.20 would have applied.</p> <p>The Panel finds that no "specialized anthropological and sociological experts" were consulted in this decision, contrary to intention of OD 4.20.</p>	187, 191, 203	<p><b>Comment:</b> Management agrees with the Panel that the Afro-Colombians did not meet two of the policy criteria under OD 4.20 and there has been compliance with the OD. Moreover, the Project's safeguards specialists drew on the research undertaken by an expert local anthropologist under the SIA in applying the criteria concerning Indigenous Peoples.</p> <p><b>Action:</b> No action required.</p>
20.	<p><b>Indigenous Peoples Development Plan</b> The Panel finds that there is no complete list, schedule or financial arrangements of mitigatory measures or compensation for the Project's risks for the people living in the area of the proposed outfall.</p> <p>Since the Afro-Colombians could reasonably have been regarded as indigenous peoples within the Indigenous Peoples policy, the Panel finds that the Bank would have been well advised to require an Indigenous Peoples Development Plan (IPDP) or similar document identifying impacts of the Project on these people and providing mitigation measures for risks and potential harm, particularly in light of the inadequacies of the Social Impact Assessment.</p>	195- 196	<p><b>Comment:</b> Since OD 4.20 did not apply, no IPDP was prepared. Concerning the Panel's finding regarding the adequacy of the SIA, and the mitigatory measures and benefits outlined in the Social Impact Mitigation and Community Development Program, see Items 12 and 13.</p> <p><b>Action:</b> No action required.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
<b>OP 10.04 – Economic Evaluation of Investment Operations</b>			
21.	<p><b>Economic Evaluation of Alternatives</b> The Panel finds that when the environmental license was issued for the submarine outfall requiring primary treatment in ten years, the Bank should have recalculated the costs of the alternative and reviewed the economic analysis in light of this new licensing requirement, to be consistent with OP 10.04.</p> <p>The Panel finds that, having acknowledged uncertainty about land prices, the analysis in the feasibility study did not then provide a clear justification for the prices used in the costing of the Project alternatives.</p> <p>Given longstanding controversy concerning the preferred option to address the City's wastewater problems, it would have been prudent to have had the Panel of Experts include a wider range of expertise, to provide more authoritative findings about both socioeconomic impacts and the economic costs of the alternatives considered.</p>	329, 335- 336	<p><b>Comment:</b> At the time of the appraisal in 1999, it was difficult to foresee the requirements emerging from the environmental license issued in 2001; therefore, any effects on the overall economic viability of the Project were not possible to include in the PAD. The economic cost benefit analysis, carried out by an internationally recognized expert (covering sewer investment, 91 percent of all physical investment), shows that even with an increase in the present value of investment costs of up to 53 percent, the Project will still yield a positive result, strongly indicating that the requirements emerging from the additional investments in year 10 will be low enough for the Project to maintain a positive return.<sup>4</sup></p> <p>The members of the POE were chosen to represent the range of expertise needed to address the highly technical and major environmental and engineering issues associated with wastewater disposal. It is Management's judgment that the use of a POE and its particular composition were appropriate to the main challenges of the Project.</p> <p><b>Action:</b> Management will update the results of the economic analysis to take into account the additional investments required by the environmental license that would need to be operational in 2015, and adjust land values.</p>
22.	<p><b>Material in the PAD</b> This section [Possible Controversial Aspects] of the PAD also cites average tariff levels and projected increases in them. However, these averages provide no information about any differential aspects on different groups in the population. This is relevant because it is an issue of some potential significance, particularly where poorer groups are concerned.</p> <p>There is little discussion about connection fees for access to new water and sewerage services, although they are potentially controversial and might influence the economic performance of Project, particularly in relation to poorer consumers, as previous Bank experience confirms.</p>	261- 262	<p><b>Comment:</b> Management acknowledges that the PAD did not adequately explain further increases in average tariff levels and lacked detailed discussions on connection fees for the poor. About 85 percent of Cartagena's population is classified as poor (strata 1, 2 and 3) according to a methodology defined by the National Department of Planning and implemented by each city. The tariff structure applied in Colombia by law is based on heavy cross-subsidies for consumption by the poor from commercial and industrial users and residential users classified in strata 5 and 6, so that families in the lowest strata are able to pay their monthly bill. Even with average tariff increases, consumers in the lowest strata will benefit from cross-subsidies. In terms of access to the water and sewer network, ACUACAR, as part of the Project design, does not charge its poor customers a connection fee, as investments to expand coverage are covered by the Project.</p> <p><b>Action:</b> No action required.</p>
23.	<p><b>Economic Viability</b> The Panel notes...that the PAD's sensitivity analysis does not report the responsiveness of net present values to variations in WTP. However, the Panel finds that the PAD did not try to make further - necessarily approximate - estimates of the enhanced tourism and</p>	281- 290	<p><b>Comment:</b> As a general recommendation, the Handbook on Economic Analysis of Investment Operations (page 106, cited in OP/BP 10.04), indicates that it is best to use the simplest measure of effects compatible with the problem to be analyzed. The Handbook recommends, under time and budget constraints of project preparation, that analysts carefully weigh the costs and benefits of added complexity. Experience indicates that simplicity seldom adversely affects the analysis.</p>

<sup>4</sup> Soluciones Integrales. Cost Benefit Analysis of the Cartagena Water Supply, Sewerage and Environmental Management Project (October 1998), supplied to the Panel during its investigation.

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	<p>recreational benefits likely to be associated with the Project, which is surprising given the acknowledged importance of tourism to the economy of Cartagena.</p> <p>The PAD notes that tourism is the main income source in the city and quotes 700,000 annual visitors and estimated revenues of USD315 million generated. The Panel finds that the Bank should have considered these benefits in order to be consistent with OP 10.04, which says that: <i>“The economic evaluation of Bank-financed projects takes into account any domestic and cross-border externalities.”</i></p> <p>Given that the Bank and other international agencies have carried out or sponsored numerous studies of willingness to pay for water and of water tariffs, the Panel expected the PAD’s economic analysis explicitly to draw on and comment on this experience, in order to explain and validate the approach taken to valuing the benefits of improved water services. The Panel observes that the economic analysis does not do so.</p>		<p>Consistent with this standard evaluation practice, tourism benefits were not included because they were difficult to quantify monetarily. Given that the Project was already yielding a positive net present value, a conservative approach was used and the economic benefits associated with tourism were not quantified.</p> <p>The economic cost benefit analysis conducted by the international expert cited in Item 21 was based on contingent valuation methodology, which explicitly draws on experiences from the Bank and the Inter-American Development Bank (IDB). Part of the analysis is based on previous studies conducted by the expert in Cartagena for an IDB financed intervention. Management acknowledges that the PAD does not comment on the results of previous studies.</p> <p><b>Action:</b> No action required.</p>
24.	<p><b>Economic Analysis Presentation in the PAD</b>  <b>- Cost Benefit Analysis</b>  The PAD notes that the evaluated infrastructure components represent 88 percent of the total Project cost. The Panel finds that no description or explanation is offered in relation to the remaining 12 percent.</p> <p>No reference is made as to whether the Bank performed any checks on the validity and reliability of data, although they formed essential building blocks for analyses. The Panel finds that, even though it would not have been feasible to scrutinize and validate all parts of these data, PAD should have examined the issue of data reliability as part of showing compliance with OP 10.04.</p> <p>The PAD does not explain whether water billing took into account the six-part tariff structure for different income groups.</p> <p><b>- Distribution of Benefits</b>  There appears to be little discussion of connection costs to new water and sewerage services in the PAD....The Panel finds this is a potentially important issue for consumers and the utility, and much may depend on how it is addressed, particularly in relation to poorer consumers, as</p>	264-270, 298, 301-302, 307	<p><b>Comment:</b> Management acknowledges the Panel’s finding that the economic analysis may have been carried out competently and broadly in line with OP 10.04, although Annex 4 in the PAD did not reflect the intensive and comprehensive analysis conducted, in particular that done by the international expert cited in Item 21. This analysis demonstrates the viability and robustness of 91 percent of the physical investments to be financed by the Bank (sewage collection and treatment), in compliance with OP 10.04.</p> <p>As noted by the Panel (para 263), a cost benefit analysis was used to measure the financial and economic viability of the investments that will be partially financed by the Bank. This included the analysis by the expert cited in Item 21 on the sewage collection and treatment investments, as well as analysis by Bank staff and ACUACAR on other physical investments. As can be seen in the Project breakdown by component (PAD, page 7), the 11.8 percent of the total program that was not included in the cost benefit analysis was related to institution building, the environmental and social component, project management, technical assistance, studies, design and supervision and the front-end fee. These costs do not correspond to physical investments and typically are not included in the economic evaluation. Management acknowledges that the PAD could have explicitly stated this in Annex 4.</p> <p>Management also acknowledges that the PAD could have pointed out more clearly that the data used for the economic analysis was checked and validated in compliance with OP 10.04. The economic cost benefit analysis was based on: (i) costs that were fully analyzed by Bank experts in the field; and (ii) contingent valuation. This approach reflected a state of the art valuation method at the time of appraisal and is best practice.</p> <p>Management acknowledges that the PAD left unsaid whether water billing took into account the six-part tariff structure for different</p>



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	<p>previous Bank experience confirms.</p> <p><b>- Sensitivity and Risk Analysis</b> While the PAD says that the risk analysis recalculated the results of the financial and economic analysis by changing “these major risk variables all at the same time,” it is unhelpful because it only sets out the probability distributions and ranges that were used for five of the variables. There is no obvious reason why this was not done for the remaining variables and it makes it impossible for the reader to gain a full picture of the procedures, underlying rationales and results of the sensitivity and risk analysis. The analysis does not discuss the responsiveness of net present values to variations in WTP, a key variable, and...the economic sensitivity analysis does not mention them... In the Panel's view, therefore, the PAD's sensitivity and risk analysis is inadequate under OP 10.04's provisions relating to risk.</p> <p><b>- Cost Benefit Analysis Summary in the PAD</b> Although underlying economic evaluation may have been carried out competently and broadly in line with OP 10.04, parts of material in Annex 4 are not presented and explained in PAD with sufficient clarity, transparency and consistency to demonstrate this compliance. This matters because partial or confusing explanations in the PAD risk failing successfully to communicate and confirm to stakeholders the nature and robustness of appraisal processes that the Bank's operational procedures like OP 10.04 promote and require. This could be important for a project acknowledged to have controversial aspects.</p>		<p>income groups. Water billing does in fact take into account this structure, which is the only tariff structure in Colombia. In the case of Cartagena, the majority of the population is in strata 1, 2 or 3 (low income), to which subsidies apply.</p> <p>Management also acknowledges that the section of the PAD summarizing the sensitivity and risk analyses does not fully set out the result of the detailed study conducted by the international expert. Based on switching values of major risk variables and Monte Carlo simulations, this analysis demonstrates the robustness of the investment program, in compliance with OP 10.04. The switching value results from this study (Cost Benefit Analysis, 1998, pages 28-29) showed that the Project would be feasible with a 35 percent reduction of the estimated WTP, and a 53 percent increase of investment costs, even if no population growth were considered. These results demonstrate the robustness of the investments. The Monte Carlo simulations reinforced these conclusions by showing that after 200 simulations, the average economic rate of return was 18.2 percent and the minimum value was 14.3 percent, with an average positive net present value at the time of 26.02 billion Colombian pesos (USD15.4 million) and a minimum of 10.02 billion Colombian pesos (USD6 million).</p> <p><b>Action:</b> No further action required.</p>
25.	<p><b>Poverty Reduction</b> In view of Project's design and locations that will be affected, there seems little doubt that substantial numbers of poor people in Cartagena are intended to and seem likely to experience significant benefits associated with provision of enhanced access to and quality of water and sewerage services.</p> <p>The footnote to Table 6 [of the PAD] says that the negative impact (presumably the loss to the poor associated with the water supply projects) “is mainly due to shadow pricing the financial benefits in order to obtain the economic benefits.” In the Panel's view a fuller explanation should</p>	344-349, 300	<p><b>Comment:</b> Management shares the Panel's views on the importance of the Project's poverty related impacts on Cartagena's poor and vulnerable population. Management shares the Panel's opinion that, if this information had been included in the PAD, external audiences may have more easily understood the Project's relevance to poverty reduction. However, the distributive impact analysis and the socio-economic information collected as part of the economic cost benefit analysis conducted by the international expert provides much of the data that should have been presented in the PAD.</p> <p>During supervision, the Bank conducted a study to further analyze and monitor the impact of ACUACAR interventions on the poor in terms of access to water and sanitation services, compared to other publicly managed utilities in Colombia. This was presented as an Annex to the PAD of the Colombia Sector Reform Assistance Project approved by the Board on October 25, 2001 and published as a stand alone note, “En Breve - Colombia: Expanding Services to Low-Income Areas,” No. 24, May 2003 (attached to this response as</p>

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	<p>have been supplied.</p> <p>Evidence on poverty impact analysis in PAD is limited to the highly aggregated 'poor'/'non-poor' columns of Table 6 in Annex 4 and eight poorly proof-read lines of text. Given that the first of the Project development objectives is to improve water and sewerage services and sanitary conditions of the city's poorest population, and where – as with many Projects that may benefit poor people – it is possible that some of the poor may gain while others lose, it is disturbing that more effort was not put in during Project preparation and appraisal to enable sufficient income and/or other data to be assembled to assess Project's impacts on the poor "with any accuracy."</p> <p>It might have been possible, for example, to augment the analysis by introducing other related evidence, such as that in the social assessment, which the PAD (p. 20) states, "proved that the Project will benefit the poorest communities in Cartagena which currently lack sanitary services." Indeed, the Panel notes that Management may well have missed an opportunity to demonstrate clearly the extent to which the Project might be consistent with the Bank's poverty reduction strategy as OP 10.04 requires.</p>		<p>Annex 4).</p> <p>While the Project does have important poverty impacts, it was not meant to be a "Program of Targeted Intervention." Management regrets the inadvertent error in this designation in the PAD.</p> <p><b>Action:</b> No further action required.</p>
<b>OD 4.15 – Poverty Reduction</b>			
26.	<p><b>Effects on the Three Communities</b></p> <p>There are...risks to these poor communities which have not been properly and explicitly addressed in the appraisal of the Project. Had this been done, it might have been possible both to reassure concerned communities about levels of risk and/or put in place fall-back mechanisms that would provide trustworthy and timely "insurance" or compensation were events to arise. In the Panel's view, therefore, in relation to risk the Bank has not complied with OD 4.15. Compliance would have meant giving greater and earlier attention to risks to and concerns of these communities, whose willingness to accept the location and consequences of the outfall was key to successful delivery of the potentially very substantial benefits intended for so many of Cartagena's other poor citizens.</p>	352, 355	<p><b>Comment:</b> See comments in Items 12 and 13.</p> <p><b>Action:</b> No further action required.</p>
27.	<p><b>Potential Impacts on Other Infrastructure Investments by the District</b></p> <p>In the Panel's view, the decision to focus</p>	357	<p><b>Comment:</b> Management notes that the 1997 Colombia Country Assistance Strategy (CAS) identifies the Cartagena Water Supply, Sewerage and Environmental Management Project as one of the proposed interventions to achieve the broader aims of the Strategy.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	<p>on water and sewerage investments was not inappropriate, but given the Project's potential consequences in keeping alternative infrastructure investments "to a minimum," the potential impact on other poverty-reducing investments should have been properly addressed. This might have given confidence that the Project was the best use of the scarce financial resources of the District, and thus have shown compliance with OD 4.15.</p>		<p>Management also acknowledges the Panel's finding that the focus on water and sewerage investments was not inappropriate.</p> <p>The CAS aimed to achieve full economic growth, reduce poverty, improve social conditions and support sustainable development. As a result, one of the six strategic areas of work was to improve infrastructure services, including the Cartagena Water Supply, Sewerage and Environmental Management Project. The Board discussed the CAS on November 6, 1997. Additionally, the Government of Colombia saw it as a priority, and thus supported it through a guarantee.</p> <p>Given Cartagena's high poverty levels, Management's first response to the Request for Inspection showed that investments made almost wholly benefit the poor. In Management's view this is fully consistent with OD 4.15. Water and sewerage are, as stated, a high priority of the current government administration, which subscribes to the Millennium Development Goals that call for halving of the number of people without access to water and sanitation by 2015.</p> <p><b>Action:</b> No action required.</p>
<b>OP/BP 10.02 – Financial Management</b>			
28.	<p><b>Financial Management Assessment and Capacity of the District of Cartagena</b>            Given the assumptions reflected in the PAD—that about 55 percent of the funds to be made available by the District would come from Unified Property Tax/Impuesto Predial Unificado (IPU) revenues – the Panel finds that the Bank should have paid more attention to the District's internal control and management problems and should have carried out an in-depth financial management assessment of the District... Since it did not, it did not comply with its own policies and procedures set out in OP/BP 10.02. The Bank should then have worked with the District on an action plan to improve the District's property tax registers and its billing and collection systems. Since the Bank was aware of the District's internal control and management problems, it should have required that District, as the Borrower of the Bank Loan, have its accounts and financial statements audited by independent auditors each year and provide a copy of the audit report to Bank. From a strict Project point of view, the Bank carried out its due diligence in accordance with its policies and procedures. However, it misjudged importance to the Project of improving the Borrower's capacity to collect the IPU taxes.</p> <p>The Panel notes that the Bank did not pay sufficient attention to the design of the financial management information requirements for the Project... The audit</p>	368-373, 386	<p><b>Comment:</b> In Management's view, the Bank fully met its financial management and assessment obligations under the Project. Bank staff carried out a detailed assessment and financial projections of the finances of the District, including a risk analysis. As a consequence of this analysis, the loan size was reduced to meet the District's financial capacity. Its counterpart funding and loan repayment capacity were based on three income streams, two of which depended on assured and stable central government transfers. The third stream, the IPU, was subject to collection difficulties as is the case in many cities in the region, but its significance was low since the share of IPU revenues going to the Project only accounts for about 3 percent of the District's overall income.</p> <p>As part of Project supervision, the Bank has engaged annually an expert to review the financial position of the District and IPU collection performance since 2000. The expert also reviews fund availability through the quarterly reports submitted to ACUACAR on the receipt and use of IPU resources. While IPU revenues were initially less than expected at appraisal, the strengthening of the value of the peso resulted in an increase in dollar terms of the funds deposited to the Trust Fund. During the last two annual reviews by the expert, he concluded that the Trust Fund was overcapitalized, meaning that more money is available than necessary to meet counterpart funding needs, and suggested a reduction in the level of contribution. Using a conservative approach, the Bank did not implement this recommendation, since the Project's final costs were not yet known.</p> <p>In 2004, the District made major progress on collecting arrears of the IPU with the consequence that it reduced its other, non-Bank debt to nearly zero, further strengthening its financial position. Counterpart funds have already been fully provided by ACUACAR and the District, and the Government of Colombia has provided more than 90 percent of its share. Management deems this a considerable achievement, since the Bank Loan is less than half disbursed. It is Management's assessment that the positive actual</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	<p>report for the year ending December 31, 2003, provides an “unqualified opinion” on the Project’s Trust Fund Financial Statements. No evidence was found on file that the Bank had received this audit report.</p> <p>In addition, in order for the national Government to extend its guarantee to the Loan Agreement, it first had to sign a Counter-Guarantee Agreement with the District of Cartagena under which the District, if it defaulted on the Bank Loan, would hand over to the Government the funds it had pledged for this Project. The Loan, Project, and Guarantee Agreements do not make any reference to this Counter-Guarantee Agreement, although this agreement contains a number of covenants that have a direct bearing on Project implementation and loan repayments. The Panel is concerned that the Bank may have overlooked this matter.</p>		<p>results (i.e., more than adequate capitalization of the Trust Fund, and adequate reporting) confirm the Bank’s judgment and approach.</p> <p>Management notes that the District’s internal control and management issues are more related to fiscal performance, e.g., municipal budget management, including revenue mobilization, than they are to financial management and the results to be expected from a financial audit. It is Management’s judgment that the engagement of another external auditor would not have yielded different conclusions from those reached by the District Controller. Regarding the Trust Fund, Management has relied on the Borrower’s own statutory auditing arrangements for financial intermediaries; the annual financial statements of the Trust Fund’s administrator, La Previsora, were audited by a reputable private independent auditor. Therefore, the Bank has not requested a separate audit report of the Trust Fund account.</p> <p>Regarding the Counter-Guarantee Agreement, all the obligations of the Borrower regarding execution of the Project, Loan, financial and other obligations are set forth in the Loan Agreement between the Bank and the Borrower. The only documents that govern the Bank’s rights and obligations are the agreements to which it is a party. The Counter-Guarantee Agreement, to which the Bank is not a party, is a contract between the Guarantor (the Republic of Colombia) and the Borrower (the District), required internally in Colombia, as a condition for the Guarantor to sign the Guarantee Agreement with the Bank.</p> <p><b>Action:</b> Noting that it is a common practice, when working with financial agents, to review audited financial information as part of supervision activities, and since the Trust Fund account is reviewed as part of the scope of work performed by the Trust Fund Manager’s auditor, the Bank will obtain and put on file annual audit reports of La Previsora.</p>
29.	<p><b>Project Financial and Accounting Statements</b></p> <p>The agreed institutional and financial arrangements for the Project specifically address uncertainties in the Requesters’ complaint, and the processes followed comply with the Bank’s OP 10.02.</p> <p>The District of Cartagena receives sufficient information and assistance from other Government institutions to manage adequately the partnership agreements.</p>	375-376	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
30.	<p><b>Financial Management Assessment – ACUACAR</b></p> <p>The Bank carried out an adequate financial management assessment on ACUACAR in accordance with Bank policies and procedures. With respect to supervision of ACUACAR, supervision reports on financial management are complete and informative. Aside from the shortcomings of audit reports that are noted elsewhere, the Bank has covered this aspect, including financial and operational internal control</p>	389-390	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>

No	ISSUE/FINDING	Para No.	COMMENTS/ACTION
	matters, very thoroughly.		
31.	<p><b>Financial Capacity –ACUACAR</b> The Bank satisfactorily carried out its due diligence during Project preparation with regard to ascertaining ACUACAR's financial capacity in line with its policies and procedures.</p>	394	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
32.	<p><b>Risk of Default on the Bank Loan</b> At the time of Project preparation, the Bank carried out detailed financial analyses and projections, including sensitivity tests, on revenue and cost statements for the District of Cartagena and ACUACAR.</p> <p>The Bank adequately carried out financial projections for the District as well as for ACUACAR and reached satisfactory institutional arrangements to ensure proper Project financing and loan repayment. The Bank carried out its due diligence in line with OP/BP10.02.</p>	401	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
<b>OD/OP/BP 13.05 – Project Supervision</b>			
33.	<p><b>Bank Supervision of ACUACAR</b> The Bank closely supervises performance of ACUACAR and complies with OP/BP 13.05 in this respect.</p>	398	<p><b>Comment:</b> Management acknowledges the finding of compliance by the Panel.</p> <p><b>Action:</b> No action required.</p>
34.	<p><b>Supervision of Audit Reports</b> The Panel finds that the Project supervision reports are generally satisfactory and quite informative.</p> <p>The Panel also finds that the decision making within the Bank, as it refers to accepting audit reports that are not fully in compliance with the requirements of the Loan Agreement, did not follow Bank procedures. Hence, it did not comply with its own policies and procedures set out in OP/BP 13.05.</p>	372-373, 388-390	<p><b>Comment:</b> Management acknowledges the Panel's finding on the satisfactory quality of the Project supervision reports.</p> <p>The finding regarding audit reports is limited to the lack of separate opinions on the Project Management Reports (PMRs), as required by the Loan Agreement (4.01 b). The fact that audit opinions of the PMRs were not issued separately from the overall audit opinion on the Project accounts does not mean that the PMRs were not audited. An independent auditor (a leading global international accounting network) carried out each year a full audit process of the information contained in the PMRs, utilizing procedures applied to the distinct components of the Project financial statements, and issuing audit opinions covering annual Project financial statements, which provide documentation of the PMR audit as part of the overall Project audit. The latest audit report for the Project was received on June 23, 2005, which addresses the financial year that closed on December 31, 2004.</p> <p><b>Action:</b> No action required.</p>



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**ANNEX 2**

**HOW AND WHY MARINE OUTFALLS WORK**

1. Marine outfalls rely primarily on currents and the size of receiving water bodies to dilute effluents. Wastewater consists of 99.9 percent water and 0.1 percent of solids, mostly dissolved and partly suspended. Effluent from a marine outfall immediately undergoes very effective mixing processes and after a short distance from the discharge point, loses its identity as effluent. Typical dilutions are more than 100:1, which is equivalent to a 99 percent reduction in contaminant levels, far higher in terms of organic matter than any conventional land-based treatment plant can accomplish.
  
2. Field studies of operating outfalls show few measurable effects of discharged sewage beyond a short distance from the discharge point. Results of five years of measurements undertaken at two outfalls in Chile (Leppe, 1999) show that even as close as 100 m from the discharge, water quality is virtually indistinguishable from natural sea water. Treatment prior to discharge is similar to that proposed for Cartagena, i.e., preliminary treatment. The combination of pretreatment and long outfall is an effective one.
  
3. The effective elimination of pollutants at such a short distance from the outfall discharge point is the result of a series of hydrodynamic dilution and biological decay processes that occur in the marine environment. These processes, often referred to as near field dilution, far field dilution, and bacterial decay, have been extensively studied (Roberts, WQI Casebook, May/June, 1998). For a well designed outfall, dilutions achieved within the near field, also sometimes known as initial dilution, are typically of the order of hundreds or even thousands to one. The combination of near and far field dilution is usually in the thousands. For example, the average concentration of Biological Oxygen Demand (BOD) and of Total Suspended Solids (TSS) in the raw wastewater of Cartagena, is about 250 mg/l for each. A dilution of 1,000:1 (a conservative estimate) reduces the concentration of BOD and TSS to about 0.25 mg/l. The oxygen content of the sea water, which is usually close to saturation (around 8 mg/l) would not be reduced below 6 mg/l, even in a limited zone, and this would have no negative impact on marine life. Organic matter, represented by BOD, will further dilute and decompose in the marine environment.
  
4. A conventional secondary treatment plant removes 80-90 percent of BOD. If Cartagena wastewater were subject to secondary treatment then effluent would contain approximately 25 mg/l BOD. After dilution (at the conservative estimate of 1,000), this concentration would be reduced to 0.025 mg/l, compared with 0.25 mg/l for preliminary treatment. The impact on the sea at either level remains negligible. Both are well below the standards for Class 1 waters as defined in the Land-Based Sources Protocol of the Cartagena Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region.

5. Contaminants in wastewater that may affect health are toxic chemicals and bacteria. Concentrations of heavy metals and other toxic material in the raw wastewater of Cartagena are lower than the levels prescribed by Colombian Law as permissible for discharge to any receiving water body, and the heavy metals concentration is also lower than the level permitted for potable water according to Decree 475 of 1998. These levels will further decrease following dilution.

6. Pathogenic bacterial contamination is the main public health risk resulting from effluent discharge to the sea. The common indicator for pathogenic bacterial contamination is fecal coliforms. The concentration of fecal coliforms in raw wastewater is about  $10^7$  MPN/100 ml. After a dilution of 3,000 (the combined effect of near and far field) the concentration of fecal coliforms is reduced to less than  $10^4$  MPN/100 ml, which is still high. Outfalls help to address this problem through the physical dilution processes and biological decay of bacteria, since the marine environment is hostile to them. Bacterial die off is further controlled by appropriate selection of outfall length, since a longer outfall means a longer travel time towards shore and thus a higher die off. A properly designed outfall ensures control of bacterial contamination by maintaining the concentration of fecal coliforms below permissible levels, while leaving only a small area around the discharge point with higher values. Secondary treatment does not have a meaningful impact on fecal coliforms, unless the secondary effluent is disinfected through chlorination.



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**ANNEX 3**

**COMMENTARY ON “ANALYSIS OF THE  
PROPOSED WASTE DISPOSAL SYSTEM: THE SUBMARINE OUTFALL”  
(ANNEX B OF THE INSPECTION PANEL’S INVESTIGATION REPORT, JUNE 2005)**

**Introduction**

1. Annex B of the Panel’s Report contains an analysis of the waste disposal system’s submarine outfall design, with emphasis on predicted environmental impacts of the waste, in particular coliform bacteria and nutrients. That Annex states that the Panel’s reviewer agrees with the calculations performed for near field dilution, but finds the far field analysis unreliable, because near surface stratification of the water column was not accounted for and the rate of decay of pathogens was overly optimistic. The analysis in Annex B goes on to state that a different design for the outfall (e.g., an outfall extending 7000 meters offshore to a depth of 60 meters, with a 1520 meters diffuser having 152 ports) could provide a satisfactory solution for safe disposal of the nutrient, organic and pathogen load. Annex B in the Panel’s report also recommends verification of this conclusion using a three-dimensional regional model with an embedded diffuser algorithm and including simulations that incorporate the inflow from three adjacent rivers, regional winds, open boundary conditions, and water stratification.

2. Modeling the effect of the submarine outfall proposed under the Project is a highly technical effort, the results of which are highly dependent on the assumptions used and the quality of the data available as input to the model. Given the sensitivity and the importance of predicting the effectiveness of the outfall, ACUACAR contracted an independent expert specializing in the design of marine outfalls (also a member of the POE) to review the modeling presented by Hazen and Sawyer in the Feasibility Study. The expert presented a series of reports that supplemented this modeling with another approach, which used new oceanographic data as they were received. The expert submitted the final report, *Dilution Modeling for the Cartagena Ocean Outfall*, to ACUACAR in October 2003 (reproduced as Annex 3 of Management’s Response to the Request for Inspection, May 2004). This same expert has reviewed Annex B and provided the commentary that follows.

**Commentary on Annex B of the Investigation Report<sup>5</sup>**

3. A distinction must be made between “pathogens” predicted to occur in the raw sewage effluent and total coliforms. While total coliforms would occur at concentrations of about  $10^{11}$  per  $m^3$  (i.e.,  $10^7$  per 100 ml), coliforms per se are not pathogens and the concentration of pathogens in raw sewage is not  $10^{11}$  per  $m^3$  (i.e.,  $10^7$  per 100 ml) as stated in Annex B of the Panel’s Report. Annex B states that these “pathogens” must be

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<sup>5</sup> Commentary prepared by Philip J. W. Roberts, PhD, PE, Consulting Engineer.

reduced to levels of “ $10^7$  counts  $m^{-3}$ ” (i.e.,  $10^3$  per 100 ml) for the water to be “safe for human contact.” These are not the design criteria used for this outfall, nor are they usual outfall design criteria. The outfall is designed to meet the generally accepted bathing water standards of the California Ocean Plan, which states that the level of total coliforms should not exceed  $10^3$  per 100 ml for more than 20 percent of the time. The outfall will also meet the new World Health Organization (WHO, 2003) bathing water standards for Class A waters, which specify that the 95<sup>th</sup> percentile level of enterococci shall be less than 40 per 100ml. Absolute bacterial levels are not used for outfall design.

4. Annex B states that a bacterial decay rate ( $T_{90}$ , the time for 90 percent of the bacteria to decay) of 2 hours was used in the model simulations. This is not a correct reflection of what was done; in fact, a diurnally varying  $T_{90}$  was used, ranging from 1.5 hours to 20 hours. The average  $T_{90}$  value was actually 11 hours, which is more conservative.

5. Annex B quotes evidence that coliforms regrow in water. The evidence stated, however, appears to be for fresh water. No evidence that this regrowth can occur in a marine environment is cited.

6. The usual procedure for designing marine outfalls is to ensure that they meet standards for bacterial indicators, such as total and fecal coliforms, and, more recently, enterococci, all of which were considered in the outfall design.

7. Although Annex B points out that the nutrient input from the proposed outfall is negligible compared to that of the Magdalena River, it goes on to state that nutrient levels must be reduced immediately (i.e., in the near field) to near background levels to avoid any nutrient impacts on the receiving waters. This line of reasoning leads to a near field dilution requirement of 1000:1. The assumption that nutrients must be immediately reduced to background levels is neither a usual assumption nor a usual design criterion. The basis for this assumption in Annex B is not clear; the author of this commentary knows of no marine outfalls that have been designed with this requirement nor of any marine outfalls designed to more usual criteria that have caused nutrient water quality problems. Calculations provided in Annex B reach the same conclusion concerning dilution criteria for BOD, but, again, the assumption that BOD must be immediately reduced to background levels seems to be arbitrary and has little or no precedent.

8. Section 4.1 of Annex B states: “The proponents arrived at the proposed outfall design after extensive analysis and modeling under the assumption that the water column in the area of the outfall was well-mixed vertically.” This assertion is incorrect; density stratification was used in the near field model to determine near field dilution and plume rise height. The procedure is described in Roberts and Carvalho, 2000. The stratification was usually too weak, however, to prevent the plume from surfacing and the plume was usually predicted to be at the water surface.

9. Annex B uses Figure 8a, reproduced from Roberts (*Dilution Modeling for the Cartagena Ocean Outfall*, October 2003) to show “...strong stratification (0.2 to 1.0  $kg/m^3$ ) over the top 3 to 5 meters of the water column in about 50% of the profiles.” This

appears to be a puzzling conclusion to have been drawn from that figure. In fact, the individual profiles (Annex 4 of Hazen and Sawyer, 1998) usually show little stratification over the water column, and the top 5 meters show only occasionally stronger stratifications. Thus, the estimates in Annex B of the magnitude and frequency of stratification in the upper layer are considerable overestimates.

10. Annex B presents an analysis of surface wind-induced currents that include the effects of near-surface stratification as represented by the buoyancy frequency,  $N$ :

$$L = 0.429u_*N^{2/3}t^{5/3}$$

where  $L$  is the distance traveled under a wind that results in a friction velocity  $u_*$  in time  $t$ . This equation is then used with estimates of onshore wind speed and frequency to estimate onshore travel. As discussed above, however, the values of  $N$  are overestimates, leading to overestimates of onshore travel. For periods of “tranquil winds,” calculations in Annex B consider buoyant spreading of the plume to be the dominant mechanism transporting it to shore. The author of this commentary questions these methods and assumptions. First, the analysis presented is for single plumes and neglects plume merging, and second, the analysis does not account for effects of interfacial friction on the spreading layer that will slow the rate at which the surface spreads. Even allowing for these factors, it is unrealistic to assume that buoyant spreading will dominate for long time periods and that there will be no surface currents during periods of calm winds. For example, records of the Acoustic Doppler Current Profiler show currents exceeding 5 cm/s for 87 percent of the time; the surface layer will not be stationary when there are no winds.

11. Even if one were to accept all the assumptions and methods used in Annex B, the conclusion that bacterial standards will be exceeded at the shoreline for 75 percent of the time is highly misleading. This is a cumulative number. In other words, this statement means that the standard may be exceeded *at some point* along the coastline for 75 percent of the time. This is not relevant to water quality occurring at a specified location, and water quality standards are neither written nor interpreted in this way. The standards refer to the frequency of exceedance at a particular location. These exceedances are computed and presented in this way in the Project’s modeling reports, which show much lower values than those in Annex B. Even using the methods put forth in Annex B, the frequencies of exceedance *at any particular location* would be much lower than the stated value of 75 percent.

12. Annex B states that winds were neglected in the Project’s analyses. This is only partially true. The actual current records, which include wind effects, were used to predict transport of the waste. Measured currents very near to the surface were not used, however, nor were wind records explicitly used to predict current movement very near to the surface. These phenomena will be further investigated through the use of wind records extending over a period of several years.

13. Annex B assumes winds from the north (the prevalent wind direction) are onshore, even though the closest shoreline to the south is about 20 kilometers away. The

conclusions of Annex B imply, however, that this wind will bring the plume to nearby shores. The assumption that northerly winds are onshore and have an impact on the shore near Punta Canoa is not considered correct by the author of this commentary.

14. Computations of water quality modeling in coastal waters are difficult and subject to different interpretation. Depending on the assumptions made, different outfall and diffuser designs, particularly the lengths of the outfall and diffuser, can be obtained. Annex B recommends that a three-dimensional model be used to investigate the design further. Three-dimensional models are not frequently used in outfall design. They are difficult to set up and to validate reliably and also require extensive data, particularly at the open ocean boundary, and particularly in deep stratified water. Three-dimensional models can be valuable in assessing area-wide questions of water quality, such as nutrient impacts. Given that the nutrient load is so small compared to other sources, however, there is little reason to expect impacts from nutrient levels here. Because near field dilutions are typically very high—with median values of dilution ranging from 230:1 to 250:1 in the four years during which oceanographic studies were conducted—the main water quality concerns due to outfalls are associated with bacterial transport to the beaches. The Lagrangian models used for the Project have been successfully and frequently used in outfall design.

15. It is agreed that more attention will be given to the surface waters. This will be accomplished by performing more model simulations that explicitly take into account winds measured in the vicinity of the proposed outfall. A surface current of around 3 percent of the wind speed (a usual engineering assumption) will be added to the currents measured by the Acoustic Doppler Current Profiler to simulate near-surface water motions. The simulations previously presented will be repeated to assess the effects of the winds.

#### References:

Roberts, P. J.W., and J.L. Carvalho, 2000. “Modeling of Ocean Outfall for Cartagena, Colombia.” Report Prepared for ACUACAR, June 23, 2000.

Hazen and Sawyer. 1998. “Estudio de Factibilidad para el Tratamiento de las Aguas Residuales de Cartagena y para la Disposición Final del Efluente al Mar Adyacente a través de un Emisario Submarino.”

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**ANNEX 4**

**EN BREVE (MAY 2003), COLOMBIA: EXPANDING SERVICES TO LOW-INCOME AREAS**





A regular series of notes highlighting recent lessons emerging from the operational and analytical program of the World Bank's Latin America and Caribbean Region

## COLOMBIA: EXPANDING SERVICES TO LOW-INCOME AREAS COMPARING PRIVATE AND PUBLIC WATER UTILITIES

*Maria Angelica Sotomayor*

Colombia is one of the most active Latin American countries in incorporating private sector participation (PSP) in managing water utilities. One of the community's main concerns is that reforms that treat water and sanitation services as an economic asset rather than as a social good and that allow providers to apply commercial (profit-oriented) criteria, may tend to restrict access to the services for low-income users, because they are not perceived as attractive business clients by private entrepreneurs.

The government is embarking on a water sector modernization program whose strategy is to promote PSP in water utilities. One of its objectives is to expand and improve the provision of services to the poor, so it was considered necessary to find out if the common perception of the population and the concern of the community that the private sector focuses on providing good services to the wealthy and neglects the poor, is anchored in reality and consistent with the performance of privatized utilities in Colombia. A study was carried out during project preparation to test this perception against actual experience.

### Comparing Private and Public Service Provision

The study objective was to compare the performance of private and public service providers with regard to expansion of services in low-income areas. The private water and sewerage companies operators in Cartagena, Barranquilla, and Tunja were selected, because they were the first to take on the management of large city systems in Colombia. The ACUACAR Company began operating in Cartagena in 1995. The AAA started operating in Barranquilla in 1996, and in Tunja private sector involvement began in 1997.

Their performance from these start dates, until 1999, was compared with the most efficient public utilities in the country: Bogotá (which provided information regarding water and sewerage), Medellín (excluding the metropolitan area) and Manizales (both of which provided information only on water).



### Methodology and Results

The study reviewed the extent to which the utilities had expanded services to the poor in the six cities. In Colombia, for utility rates purposes, the population in each municipality is divided into six strata. The poorest users are in stratum 1, the richest are in stratum 6. Water and sewerage tariffs are subsidized in strata 1 to 3, by law. The study used these strata to measure coverage of the

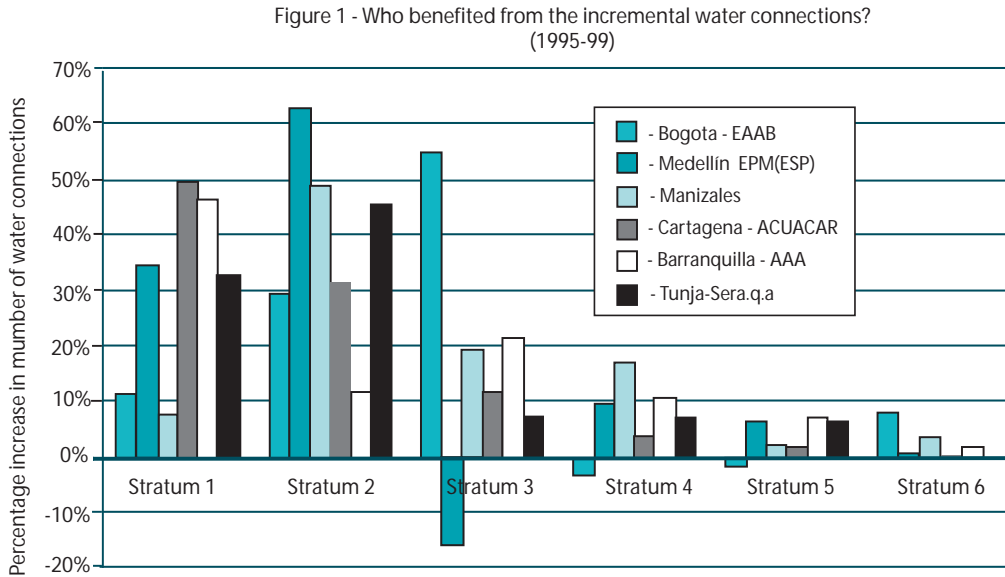
poor. Increases in the number of new connections per stratum made by each company between 1995 and 1999 were compared. Another criterion – changes in coverage in each stratum by city – was also explored. There are problems with the data needed for this calculation, particularly because the utility companies sometimes use a different stratification from the official one, as part of a commercial strategy of restratifying in order to lower rates and collect a higher volume of payments for water and sewage disposal services.

The study found that both the public and the private utilities focused their expansion efforts on low income groups (strata 1 to 3). With respect to water expansion to low income areas, the private utilities' performance was similar to that of Medellín, one of the most efficient public providers in the country. Privately run utilities focused their expansion of water and sewerage connections on users in stratum 1, Medellín and Manizales focused on stratum 2, and Bogotá

on users in stratum 3.

Figure 1 shows the distribution of new water connections by stratum over four years, 1995 to 1999. In the case of the private providers, over 45% of new water connections were for stratum 1, similar to the most efficient public provider, Medellín. The figure for the other two public providers was

operators in Cartagena, Barranquilla and Tunja with Bogotá (public). As in the case of water, Figure 2 shows that the bulk of new sewerage connections made by the three privately operated utilities between 1995 and 1999 benefit users in strata 1, 2, and 3. (The data cover 1996 to March 2000 in the case of AAA, the water utility of Barranquilla.) New sewerage connections by the private companies fo-



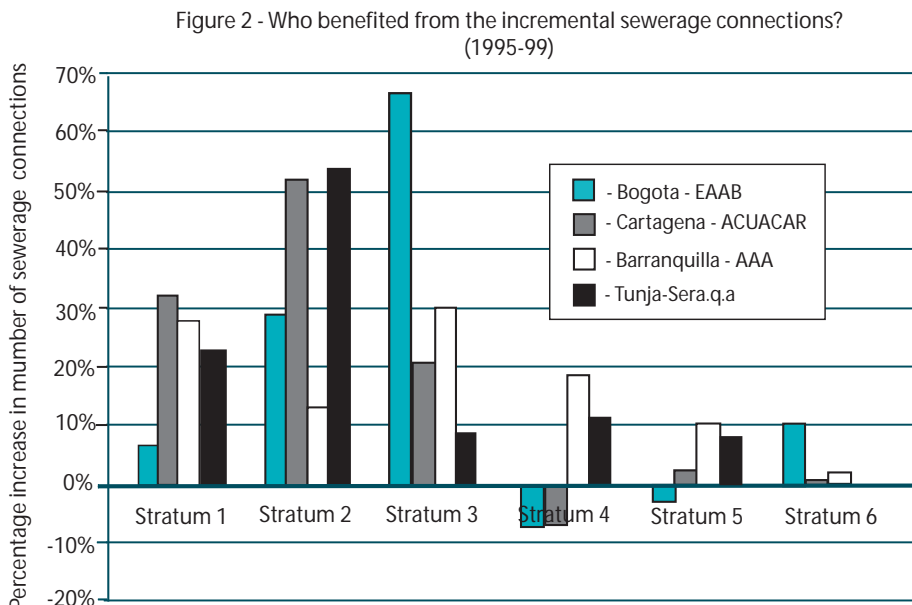
11% in Bogotá and 8% in Manizales. Strata 1 and 2 combined accounted for 80% of new connections in Cartagena; the proportion in Medellín; but it was only 57% in Manizales and 40% in Bogotá. Most of the new connections in Bogotá (55%) were for stratum 3 users (who receive lower subsidies) and can not really be defined as poor. The percentage of new connections in stratum 3 was 22% in Manizales, 16% in Medellín, 22% in Barranquilla, 12% in Cartagena, and 7% in Tunja.

ocused significantly on stratum 1 users: 31% in Cartagena, 27% in Barranquilla, and 22% Tunja, compared to 7% in Bogotá. Most of the new sewerage connections in Tunja were for stratum 2 users (53%), the stratum 2 share was 50% in Cartagena and 13% in Barranquilla. As with water, stratum 3 received the lion's share (66%) of new sewerage connections in Bogotá. In Barranquilla stratum 3 received 30% of new connections; in Cartagena 21% and in Tunja 8%.

For sewerage services, the study compares the private sector

The study also reviewed the overall expansion of coverage by stratum from 1995 to 1999. The total number of water connections increased 38% in Barranquilla, 31% in Cartagena, and 12% in Tunja, while the increase in cities with publicly-run utilities was 25% in Medellín, 25% in Manizales, and 23% in Bogotá.

A breakdown by strata shows how the private utilities have greatly improved stratum 1 users' access to both piped water and sewerage services. Comparing the number of currently existing connections with the number at the start of the PSP process, the data show that stratum 1 water connections in-

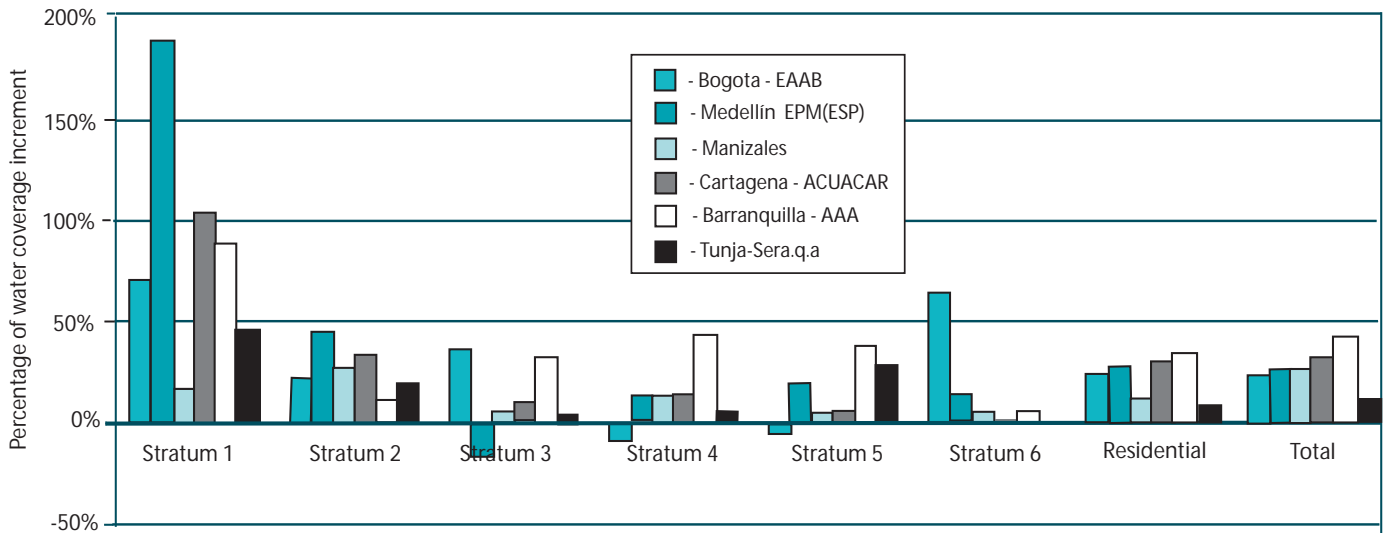


creased 104% in Cartagena and 89% in Barranquilla, following a trend set by Medellín (187%), while in Tunja they increased by almost 50%, compared with 16% in Manizales and 70% in Bogotá (see Figure 3).

Access to sewerage services also increased considerably. Figure 4 shows that the total number of connections rose 38% in Barranquilla, 23% in Cartagena, and 2% in Bogotá. For stratum 1, the increase was 235% in Cartagena (over four years) and 146% in Barranquilla (over three years). These increases are not strictly comparable with the smaller increases in Bogotá, given that Barranquilla and Cartagena started the period with far lower coverage levels than Bogotá.



Figure 3 - Coverage Increment per Stratum - Residential and Total - Water (1995-99)



However, it is revealing that Bogotá increased sewerage connections by 46% for stratum 1 and by 56% for stratum 6, whereas in Cartagena and Barranquilla the increases in total connections for stratum 6 were only 2% and 6%, respectively.

### Conclusions

This study found that private utilities are responding to the service needs of users at all income levels. In fact, most new

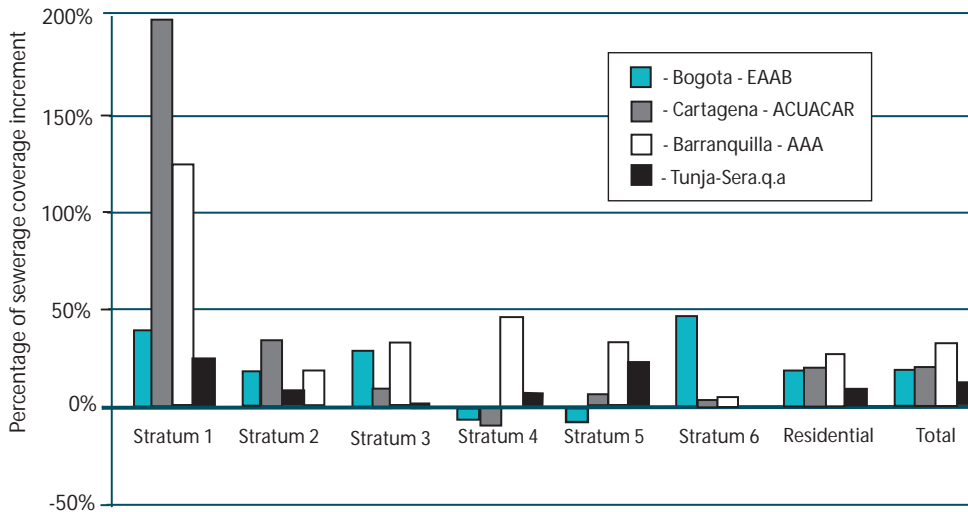
streamlined their work force and had a major positive impact on poor households. Since the private operator took over in Cartagena, 98% of new connections were in strata 1 and 2. In Barranquilla the corresponding figure was 86%, in Tunja 79%, and in another private utility, Santa Marta, over 50%.

It should be explained that when the private operators took over the utilities in Cartagena and Barranquilla, coverage was lowest among low-income inhabitants, as in most cities in Latin America. As the private operators sought to increase coverage in compliance with their contracts, the way

to do so was necessarily by increasing the number of new connections in the poorest, least well covered areas. In Cartagena, coverage of strata 1 and 2 rose from 65% to 85%. Analysis of new connections shows clearly that, even without contractual obligations expressly requiring operators to serve inhabitants in strata 1 and 2 (as in Cartagena and Barranquilla), users in these strata are receiving connections at a pace similar to that of Medellín, and even higher than that of areas covered by other public utilities, such as in Bogotá and Manizales.

It should also be noted that in the period under review all utilities

Figure 4 - Coverage Increment per Stratum - Residential and Total - Sewerage (1995-99)



connections by privately run utilities benefited users in stratum 1. It can be asserted that privately operated utilities have not impaired the interests of low-income users, specifically those in strata 1 and 2. In five years of private participation in the water and sanitation sector in Colombia, municipalities with private operators have improved their coverage and continuity of service indicators substantially,

received national and/or local government support for connecting new low-income users. Irrespective of who paid for the new connections in strata 1 and 2 made by the Cartagena and Barranquilla utilities, it remains true that these private utilities substantially raised the number of connections for stratum 1 in a relatively short period of time, which was not achieved in most of the public utilities in the country. Users

in strata 1 and 2 are better off than they were prior to the arrival of the private sector operators, because their publicly-run predecessors had excluded the low income strata for years. In many cases, poor public sector incentives and inefficiency of public utilities impeded expansion even with subsidies and government transfers, whereas private operators have greater incentives to invest in low-income areas, to increase market volume.

Private utilities are generally more efficient than public utilities for a number of reasons:

- Public utilities sometimes become political fortresses of the government. They are subject to political interference in decision-making, especially with respect to the appointment and withdrawal of managers. They tend to be overstaffed and to siphon off budget funds to cover administrative costs, preventing funds from being directed to new investment.
- Often, the rates charged for services do not cover operating and investment costs. Municipal authorities are unwilling to face the political costs of rates hikes.
- At best, rates only cover operating and maintenance costs and the municipality is supposed to provide funds to the public utility for investment and to cover deficits. Usually these funds barely cover very short-term investments or contingencies.
- Public operators put off investing in new connections due to lack of funds or because users have problems complying with current regulations. Would-be users must have title deeds and a building registration certificate before properties can be connected. In the specific case of Bogotá, the last administration regularized the status of 300 irregular districts, paving the way for water distribution and sewage disposal connections for almost 500,000 people. Barranquilla and Cartagena each have a large number of “informal” districts. Nevertheless, private operators have taken steps to mitigate the effects of this and do not make legalization of properties a condition of access to service. Some of those steps include shared connections or outlets, often for a whole block, from which water is then distributed to neighbors. An average rate is charged for water consumption. Communities organize themselves and control both consumption and collection of payments.

It has been shown that PSP processes rapidly achieve improvements in coverage rates and the quality of services, especially in municipalities which used to be particularly deficient in these respects. Raising the number of users in all strata is part of the commercial strategy of private operators. The low-income population thus benefits rapidly because it constitutes a new clientele. In addition, private operators can more easily tap short-term funds to invest in new connections. Public utilities generally have less investment capac-

ity and are less efficient in allocating resources, causing delays in expansion of coverage that negatively affect the low-income population, which is the segment least likely to have access to the services under publicly-run utilities.

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### **Water Supply and Sanitation in Latin America and the Caribbean**

Reducing poverty is not possible without delivery of clean water to the 1.1 billion people who currently do not have access to it. Nearly three-quarters of the poor people living in rural areas worldwide do not have access to clean water or to reliable sanitation services. As a consequence, more than three million die each year of avoidable, water-borne diseases.

In the Latin America and Caribbean region (LAC), it is estimated that 76 million of the region’s 510 million people do not have access to safe water and 116 million lack access to sanitation services. Clean water is in very short supply in many places. In towns and cities, where people depend on elaborate systems of aqueducts, pipes, treatment plants and sewers to get their water, the needs are pressing: 26 million people living in urban areas don’t have an improved source of water, and 50 million don’t have sewerage service. Often, the poorest must pay inflated prices for water delivered by truck to their unserved settlements. In fact, poor people in the developing world pay on average 12 times more per liter of water bought than fellow citizens connected to municipal systems. In slums around many cities, the cost of water accounts for a large part of household expenses – 18 percent in Onitsha, Nigeria and 20 percent in Port-au-Prince, Haiti.

The lack of coverage for quality water and sanitation services has an impact on the environment, as well. In Brazil, where there is a great disparity between the rich and the poor in terms of the levels of coverage and quality of services, less than 20 percent of wastewater is treated and the remainder is deposited into other nearby bodies of water.

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### **About the Author**

Maria Angelica Sotomayor is an economist in the Water and Sanitation Cluster of the Latin America and the Caribbean Region of the World Bank.