



00001163597

C1
V2

URS

2005

*Environmental Evaluation of the Water
Options in the Indio, Caño Sucio
and Toabre River Watershed
Project No.SAA-117595
Final Report - Annex*

*Prepared for:
Panama Canal Authority*

*Prepared by:
URS Holdings, Inc.*

Panama – May, 2004

UNAUTHORIZED USE OR DUPLICATION IS PROHIBITED
PROHIBIDA LA REPRODUCCION SIN AUTORIZACION
DEL AUTOR

ANNEX – 1

TEAM MEMBERS

Project Director - Ron Giovannelli

Mr. Giovannelli has over 25 years of experience managing, coordinating and directing hydraulic resource and engineering projects. His technical experience centers on ideology**, hydraulics, water quality, groundwater, water supply, wastewater management and environmental impact assessments.

Project Manager and Senior Ecologist – Alberto Vega

Mr. Vega's more than 25 years of professional experience include implementation of sustainable development, resource conservation and environmental planning projects. His experience centers on environmental impact assessments, resource conservation, basin management, water quality control of lakes and dams, institutional development and environmental policy.

Office Manager Panama - Juan Vallarino

Mr. Vallarino, the URS office manager in Panama, has a degree in Civil Engineering and a Masters in Environmental engineering specializing in management of hazardous waste and ISO 14000 environmental audits. Mr. Vallarino has participated and managed several environmental projects for national and international clients.

Quality control coordinator (QA/QC) - John Rañon, P.E.

Mr. Rañon is a civil engineer with over 28 years of experience in infrastructure projects. For over 13 years he directed a civil engineering and landscaping firm in Tampa that planned, designed and provided administrative service for construction to clients in more than 300 projects.

QA/QC Environmental Aspects - Luis Ferrate

Dr. Ferrate, PhD in geography, works as an independent environmental consultant. Presently he advises on environmental policy, management, design and strategy for national and regional programs concerning social crisis and natural phenomena, and he inspects the design and implementation of environmental projects and programs or planning.

QA/QC – Social Aspects - Stephen McGaughey

Dr. McGaughey, PhD in economics, works as an independent consultant. His most recent clients were the Inter American Development Banks in Dominican Republic and in El Salvador. His expertise centers on sustainable development programs and policy, natural resources and environment, rural development and agricultural policy, among others.

Geotechnician - Ramón Martínez

Dr. Martínez, PhD in geotechnical engineering, is a college professor and has more than 18 years experience in his field. He was involved in the management and direction of geotechnical and interdisciplinary projects in the US and various Latin-American countries. His experience centers on soil engineering and the creation of geotechnical structures.

Hydrologist/ Sediment Removal - Fernando Miralles

Dr. Miralles is a senior hydraulics engineer with more than 10 years experience in simulation modeling and remote sensors of water resources in basins and urban systems, in piping hydraulics, and in the analysis of water distribution and quality

control. Furthermore he is a faculty member at the Massachusetts Institute of Technology (MIT), Northeastern University and the University of Miami.

Group leader of Biological Sciences and Senior Zoologist - Dr. Douglas Reagan

Dr. Reagan, PhD in zoology, has more than 25 years experience in zoology and terrestrial ecology. Currently he leads a Technical Management of Ecosystems group for URS and participates as a senior consultant in environmental impact studies, effects on natural resources and environmental evaluation projects.

Botanist - Dr. Ricardo Calvo

Dr. Calvo, PhD in Biology, has more than 15 years experience in investigation of plant ecology and environmental consulting. His expertise is plant ecology and botany, environmental studies, analysis and mitigation of impact, management and licensing of natural resources, and ecological and environmental modeling and planning.

Aquatic Ecologist - Dr. Manuel Basterrechea

Dr. Basterrechea is a PhD in Civil and Environmental Engineering. He has more than 20 years of experience and has acted as senior consultant on a wide variety of natural resource and environmental efforts for various national and international organizations such as: IDB, AID, Unicef, PAHO, etc.

Sociologist / Anthropologist - Dr. Gerald Murray

Dr. Murray, PhD in Anthropology, is an associate professor of anthropology at the University of Florida. He has published two books and 21 articles and prepared 56 briefs on applied anthropology for various agencies in more than 13 countries.

Sociologist / Public Participation Planner – Carmen Quintero

Dr. Quintero, PhD in sociology, has vast experience in the production of continuing education workshops, the design of opinion polls and population polling and studies. She is a professor of sociology at the University of Panama and has served as Chief of Staff of Social Investigation for the Ministry of Housing.

Economist - Dr. Gustavo Arcia

Dr. Arcia, PhD in Agro Economics and Applied Econometrics, works as senior consultant in policy for social and economic sectors for international development agencies and organizations such as the World Bank and the Inter American Development Bank.

Marine / Fishing Resources - Rigoberto González

Mr. González has a Masters in Marine Biology and has participated in various national and international projects. He did research for the Center of Marine Sciences and Ichthyology of the University of Panama and for the flora and fauna inventory of the Coiba Island National Park. He was a biologist in the department of rivers and lakes of the national aquaculture directorate for the ministry of agricultural development, as well as for the Entomology Unit of the Panama Canal Commission, and he was a species consultant on endangered fish species in continental waters of El Salvador, among others.

Simulation and Modeling - Clinton Thurlow

Mr. Thurlow is a Coastal Resources engineer with more than 10 years experience in computerized numeric models applicable to physical processes in tropical and

subtropical environments. He's well acquainted with applications developed by USACE and was in charge of the programs WMS and HEC-RES RESSIM used for the identification of options and performance evaluation, respectively.

Archaeologist - Emlen Myers

Dr. Myers, PhD in anthropology currently works as group leader and manager of the Cultural Resources Group of the National Capital of URS. His field of expertise centers on archeology, anthropology and cultural history, Latin-American archeology, cultural resource management, integration of cultural resources in studies on environmental planning and development, and implementation of protection programs for cultural resources.

ANNEX 2-A

METHODOLOGY FOR THE CREATION OF A SURFACE FLOW MODEL FOR THE INDIO, THE CAÑO SUCIO AND THE TOABRE RIVERS IN THE ROCC BASIN

1. Introduction

To analyze the possible environmental effects associated with the development of utility options of hydraulic resources in these river's basins, a model was developed to estimate average annual runoff at any point in the main rivers and their tributaries. The final result was summarized in a map of the average annual runoff with runoff isohyets spaced at intervals of 250mm/year. In order to estimate annual runoff of any subbasin or microbasin in the surveyed area one must superimpose its area on the runoff map and integrate the value of the total runoff.

2. Model Development

Conceptually, the model was developed on the basis of the relationships that explain water flow in ecosystems according to the ecological classification system known as Life Zones. Average annual runoff (mm/year) results from the difference of precipitation (**P**) minus real evapotranspiration (**ETR**). These calculations were made via digital processing of images of various variables that are converted to digital values in areas of 10 x 10 meters, what is known as a pixel (picture element). Some of the images needed for the model, a digital topographic model of the site provided by the ACP generated by radar imaging from IF-SAR was used as a fundamental variable.

The application of the model to the existing data, including value assignations of **P** and **ETR** to each 10 x 10 meter pixel, was done with the help of the modeling and simulation capabilities of the ERDAS IMAGINE software package using the Model Maker module.

To select only the areas covered by the pixels that correspond to each of the surveyed subbasins, the corresponding vectorial coverage of the subbasins of the Toabré, Caño Sucio and Indio rivers were used. This insured that all calculations and estimates were performed solely in the area of interest of the study.

2.1 Estimating Precipitation (P**)**

The image of precipitation for each pixel was generated from an isohyetal map provided by the ACP as a vector file (figure 1). This map was rasterized with a spatial resolution similar to the 10 x 10 m digital land model with the help of the ERDAS IMAGINE topographical analysis model, creating a three dimensional surface based on lines of equal precipitation.

2.2 Estimating Real Evapotranspiration (ERT)

Real evapotranspiration (ERT) was determined based on a nomogram of water movement in the natural ecosystem according to Life Zones. The ERT curve for the range of incidental climate factors for the surveyed area can be approximated using the following equation:

$$(1) \text{ ERT} = \text{EPT} * (1 - (0.4 - \text{ETP}/\text{P})^2) * 0.92$$

EPT is the potential evapotranspiration and P is precipitation

It is important to consider that the real evapotranspiration obtained by this equation corresponds to the climax vegetation in that life zone, known as Climatic or Zone Association. Ecosystems intervened by man normally have less real evapotranspiration due to the reduced plant biomass. This can be corrected by stating that where the ecosystem's mature vegetation is forest it is a function of height of the dominant vegetation multiplied by four if the vegetation is shrubland and by eight if it's grassland. The relationship used for correcting the actual use of lands equation is as follows:

$$(2) \text{ ERT-VE} = (1 + (\text{HVE}/\text{HVM}) \times \text{ERT-VM}/2)$$

Where: **ERT-VE** is the real evapotranspiration of the existing vegetation;

HVE is the dominant altitude of the existing vegetation. When the vegetation is grassland the altitude is multiplied by 8 and when it's shrubland it's multiplied by 4;

HVM is the altitude of the mature vegetation; and

ERT-VM is the real evapotranspiration of the mature vegetation

2.2.1 Estimating Potential Evapotranspiration (EPT)

In the system of Life Zones, the Potential Evapotranspiration is a function of the biotemperature (T_{bio}) and a constant (58.93) defined by the following equation:

$$(3) \text{ EPT} = 58.93 * T_{bio}$$

It is therefore necessary to define biotemperature as well as a practical way to estimate it.

2.2.2 Estimating Biotemperature

The concept of biotemperature in the Life Zones system refers to the range of temperatures at which the ecosystem can effectively photosynthesize. The Life Zones system suggests zero and thirty degrees for this range. The rationale is that temperatures under zero paralyze the photosynthesis machinery and temperatures over thirty render negative photosynthesis.

The latter is especially true for species that have a C3 carbon fixation system, in other words, most forest species found in the moist tropics.

To calculate biotemperature, values outside the range have a value of zero. Therefore estimating biotemperature requires detailed (hourly) information of the site of interest. That information is not normally available and so to make an approximation the Life Zones suggests an empiric equation that estimates adjustments in average, monthly or annual temperatures, according to the latitude of the place of interest. That is equation is as follows:

$$(4) \quad T_{bio} = T - (3 * Latitud/100) * (T - 24)^2$$

Where T is the temperature in degrees centigrade and the latitude is expressed as a decimal. The relation can be applied only to temperatures above 24 degrees centigrade.

Therefore it is necessary to generate temperature (T) values for each 10 x 10 m pixel.

2.2.3 Estimating Temperature Values

The average annual temperature (in degrees Celsius, °C) of the surface air was calculated with the help of **altothermic equations** developed by the department of Hydrometeorology of the IRHE. The necessary temperature information for the development of these equations was obtained from select weather stations that had at least five years of continuous thermal readings available from 1978 to 1983. The altothermic formula used in estimating temperature is:

$$(5) \quad T = 26.9006 - 0.0055(H)$$

Where H is altitude of the locality expressed in meters above sea level. The numbers (26.9006 y 0.0055) correspond with the average value of the monthly formulas calculated by IRHE

Applied to pixels of 10 x 10 meters this relation generates a raster temperature map (Figure 2) used as a starting point to estimate the potential evapotranspiration and then real evapotranspiration.

The temperature (T) image was generated by applying the mentioned coefficients over the image of the digital land model (H), which explains why the resulting temperature image maintains the geometric characteristics of spatial resolution and projection of the digital land model, in other words, the same 10 x 10 m pixel size and the same geographic projection, which allows the superimposition of other images (UTM, Esferoide Clark** 1866, NAD 27 / Canal Zone).

2.2.4 Procedures for Simulation

Once the procedure to calculate each of the aforementioned pertinent variables had been defined, calculations were made on each variable with ERDAS IMAGINE software. Each variable was stored as an independent image that covered the whole area of interest.

The first consideration for the simulations was the woodland that covered the entire area and then adjustments were made considering the use of that area as described in sections 1.2. Furthermore the simulation was done both using the correction by latitude and without that correction. This last variant was considered convenient given that the region of study is has a lower average temperature compared with other regions within the same latitude, temperature is expected to fluctuate less with little or no time fraction superior to the critical value of 30 degrees centigrade.

The EPT, ERT and runoff calculations were based on the spatial resolution of the 10 x 10 m pixel size that represents 100 square meters per pixel. All the pixels of the image were automatically classified based on the magnitude of the variable represented by the image. The information generated not only an image but also a table in which the first column represents the frequency, or histogram for each of the classes, which when multiplied by 100 equals the accumulated surface of each of the classes present. Finally, the total estimated value of the area of study of each variable is obtained by multiplying the surface product in each class by the magnitude of the variable in each class.

3. Results

The application of these procedures and the integration of runoff values in the dam sites** of each of the water options considered by the ACP produced estimated runoff values for each of the options. The simulation was run with and without latitude correction and the results are summarized in Table 1.

The top of Table 1 shows the results assuming that the studied area was completely covered by mature forest vegetation. In both cases, as one can observe from the same table, the runoff value is less than the values recorded with percentages of 90% and 80% for simulations with and without latitude correction, respectively. The explanation for this is the higher evapotranspiration in mature forest vegetation, in comparison to the existing mosaic of current uses, that reduces runoff water.

The bottom of the same table shows the average annual runoff volume calculated by the model using the present values of plant coverage with and without latitude correction. In both cases the values approximated the average of runoff registered at each of the three basins. The total value is closer to the registered value obtained without latitude correction and explains the 99.64% runoff. Therefore this option was selected to generate a isohyetal map

of average annual runoff (Figure 3). The precision of this model is high and it is considered a tool that can be used to estimate runoff in areas with insufficient information or a deficient meteorological network.

The structure of the vegetation mosaic is indicated in the map by the average height of the layer of water running off annually. On the contrary, in a mature natural ecosystem that is completely covered with forest vegetation the limits of the isohyets indicate a more gradual change (Figure 4).

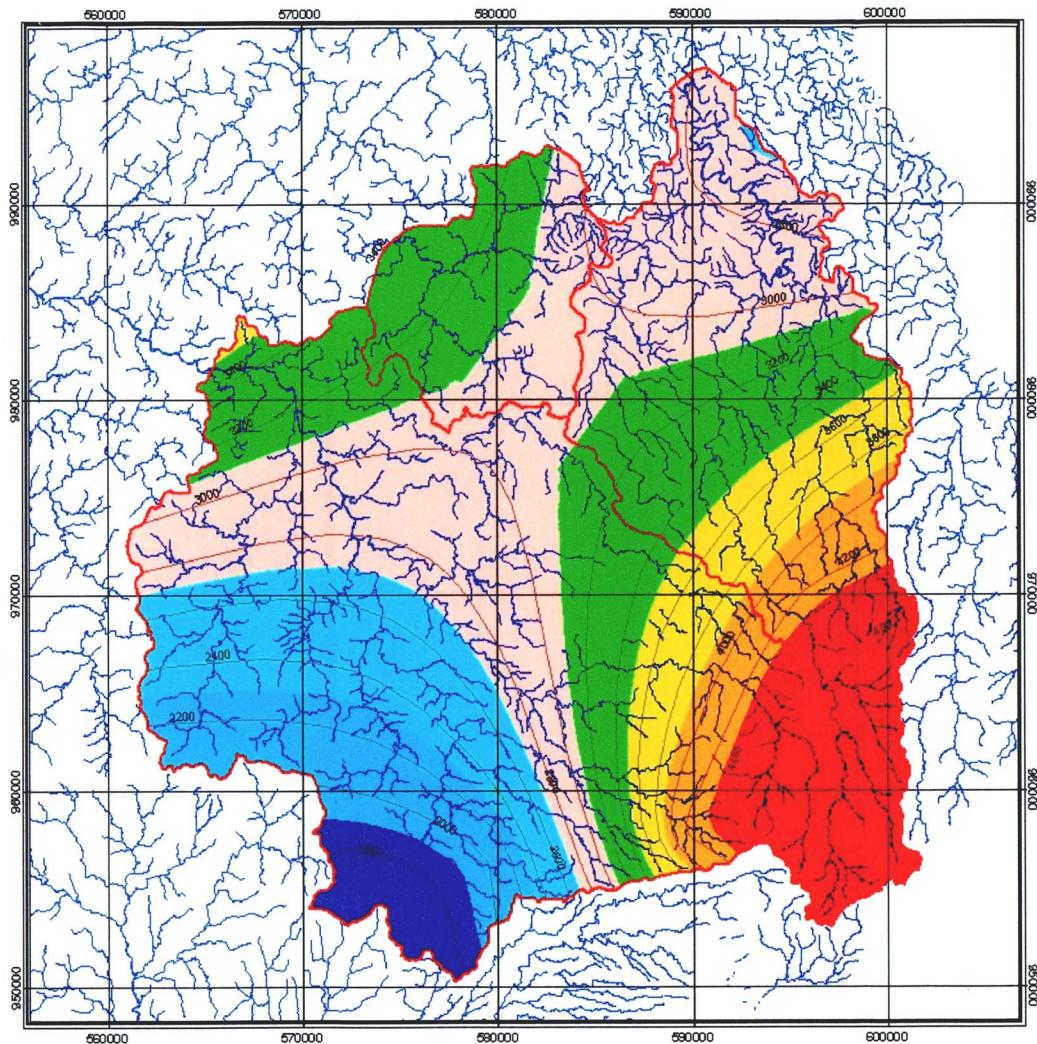
The fact that estimated discharge without latitude correction for biotemperature is closer to the existing information about flows, suggests that maybe the conditions in the area do not justify the use of that correction. It is a known fact that seasonality in the area of study is less than in the rest of the country. Therefore, daytime temperature behavior was obtained to determine if there is any evidence that justifies not using correction. Specifically the number of hours during the day when temperatures were above 30°C.

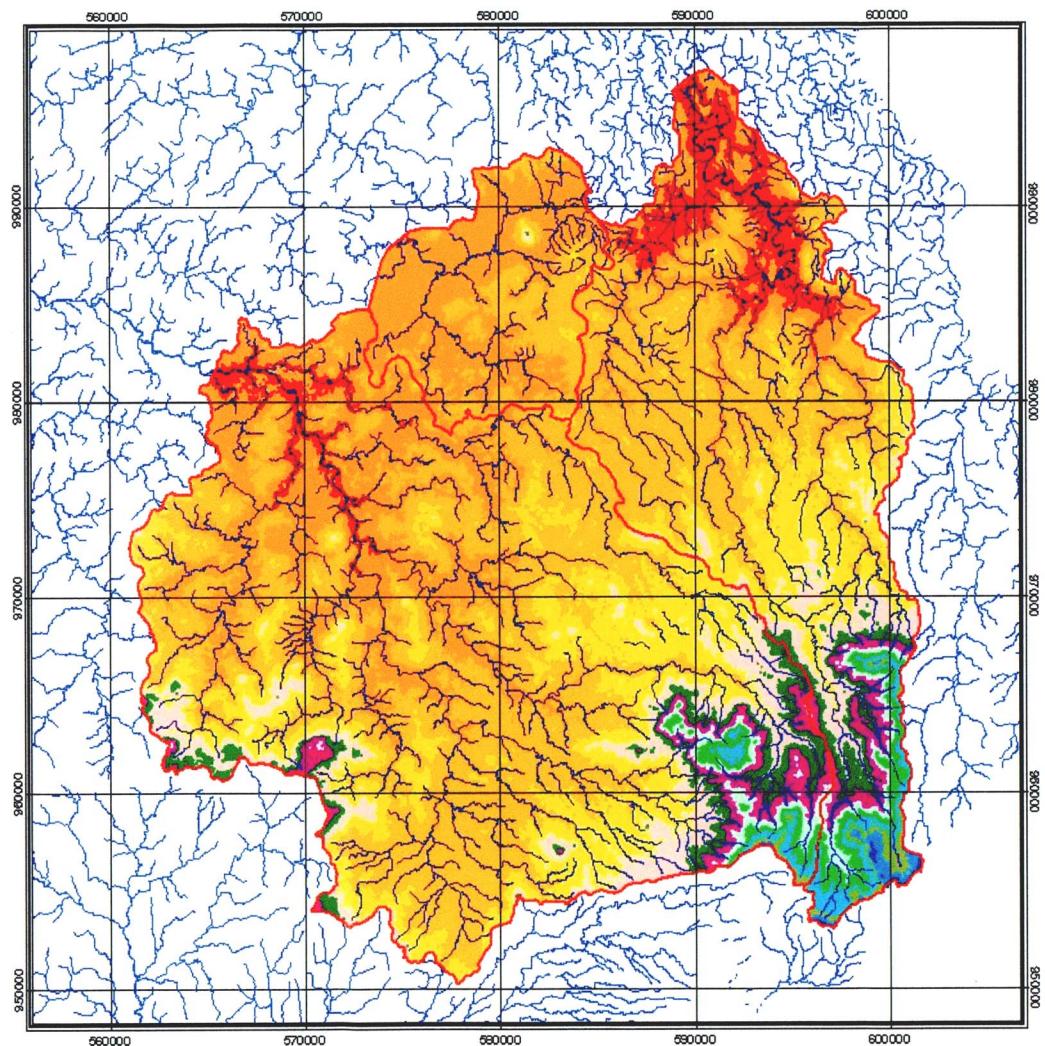
Information was available from various stations. The most representative of the whole study area was Fort Sherman. One year of information recorded at this station was chosen at random; March 16, 1998 to March 15, 1999 (Figure 5). In this figure one can see that the number of days with temperatures above the 30°C limit is insignificant. The behavior during a whole day of this year (June 11, 1998), also selected at random, shows that in effect, the temperature never reached mentioned limit (Figure 6). Therefore latitude correction is considered to be unnecessary.

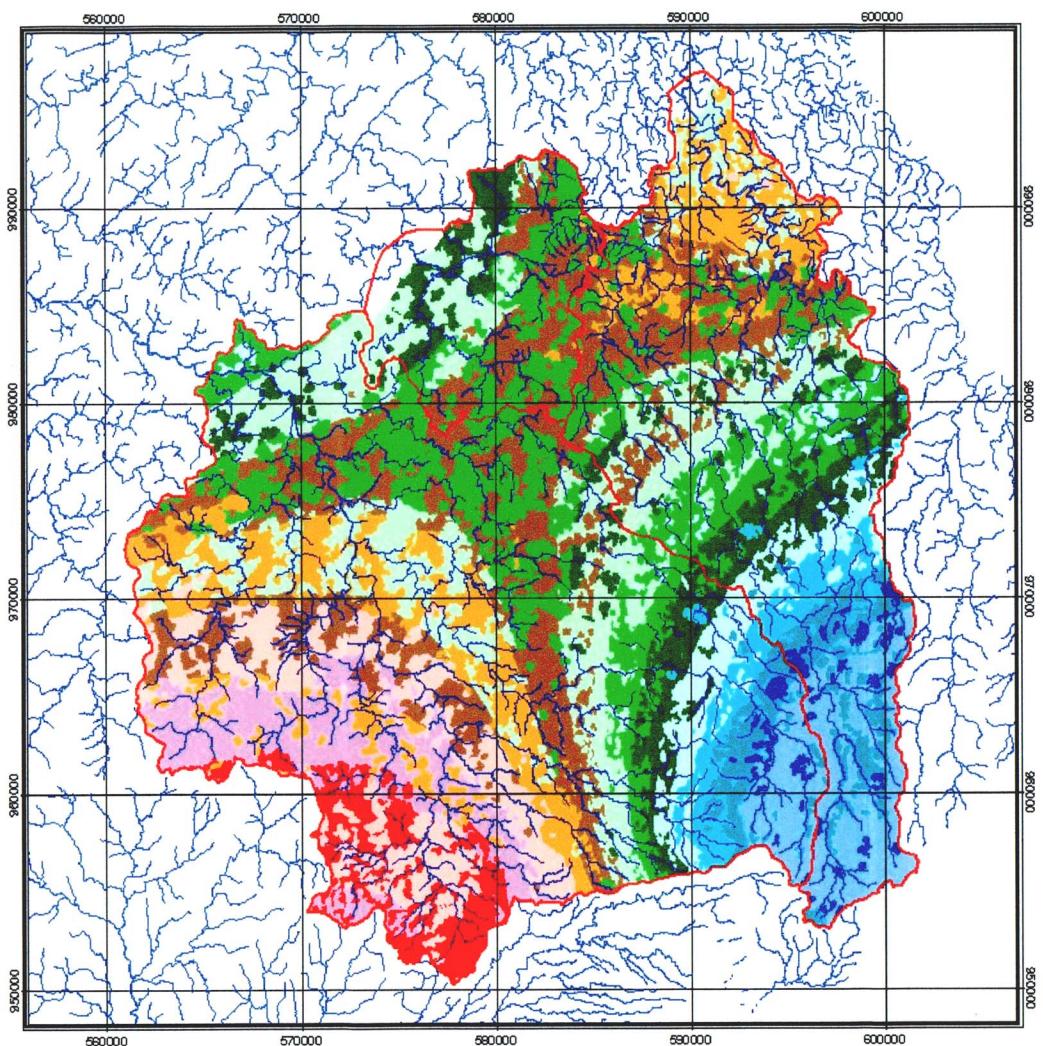
A similar analysis was done for hourly temperature information on the Island of Barro Colorado (Figures 7 and 8) that also indicate low incidence of temperatures over 30°C, although more frequent than at Sherman. This can be explained by the milder seasonality on the Caribbean coast directly west of the Canal.

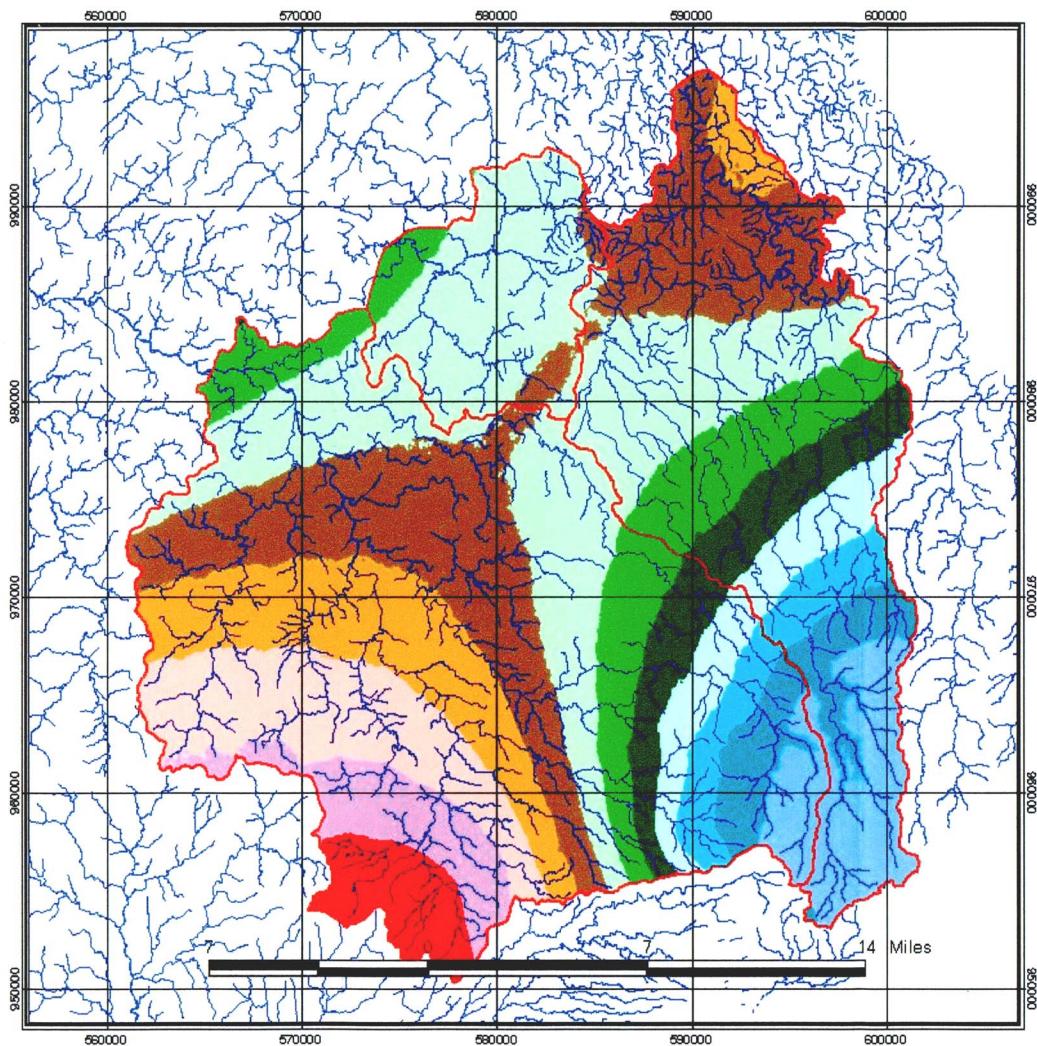
One must note that in all the model simulations the calculated runoff for the Rio Indio was above the value of the other two rivers. In the case of the model run selected to plot the average annual runoff map, the flow of Rio Indio was 5.46% higher than the average value measured in that same river. In the case of rivers Caño Sucio and Toabré the calculated flow from the model was slightly lower than the flow estimated from records, with values of 92.82% and 97.20% respectively.

This could be interpreted as an indication of a probable presence of an underground northeast flow by which the part of the water that falls and infiltrates the basin of Rio Indio is transferred to the base flow of the other rivers. Currently there is not enough information to reject or confirm this theory.





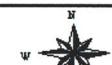




AVERAGE ANNUAL RUN OFF (mm)
IN THE OCCIDENTAL REGION

LEGEND

	Hydrographic System
	Subbasin Boundary
	500 - 750
	750 - 1000
	1000 - 1250
	1250 - 1500
	1500 - 1750
	1750 - 2000
	2000 - 2250
	2250 - 2500
	2500 - 2750
	2750 - 3000
	3000 - 3250
	3250 - 3500
	3500 - 4000

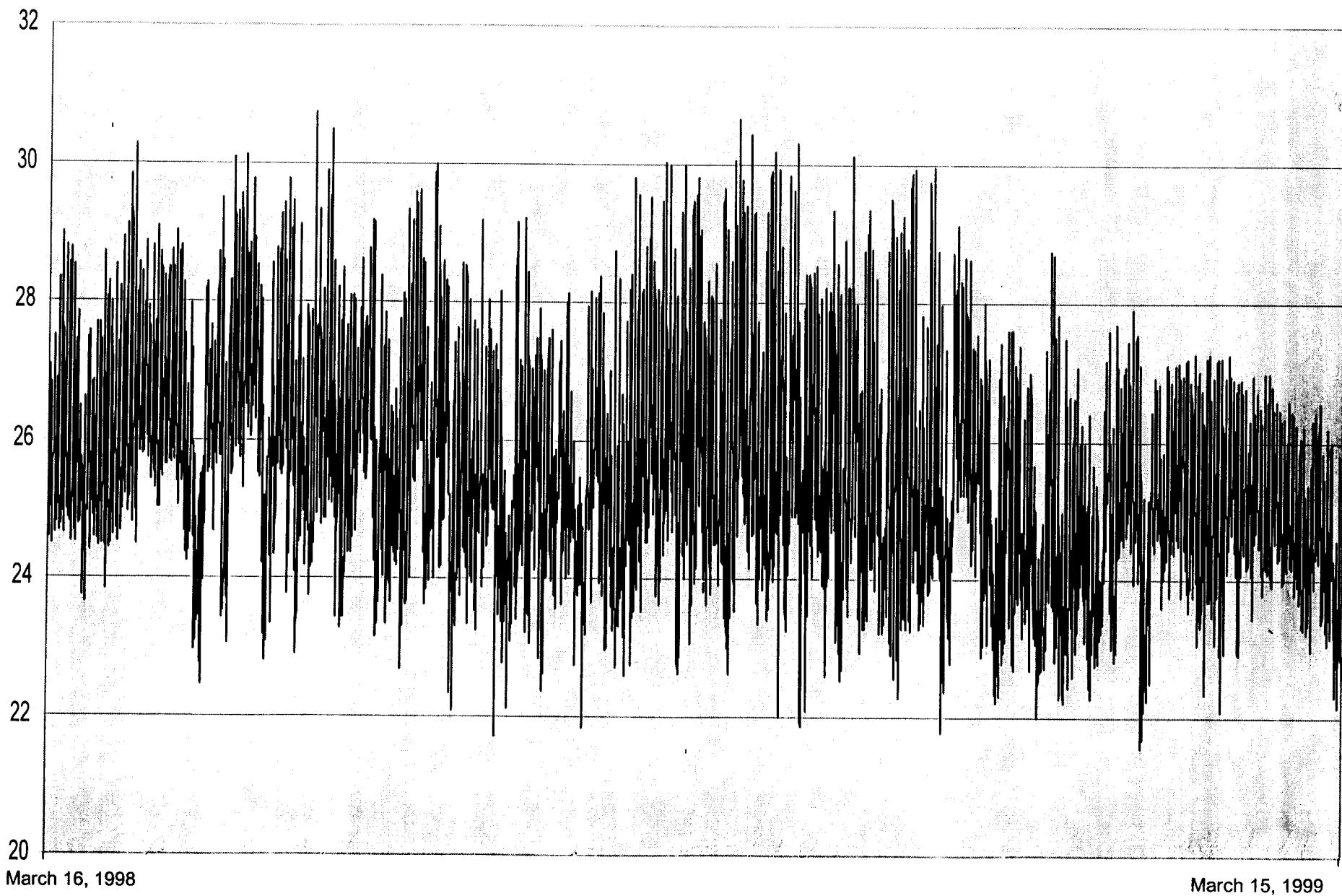


Clark 1866 Spheroid
1927 North American Datum
UTM Zone 17

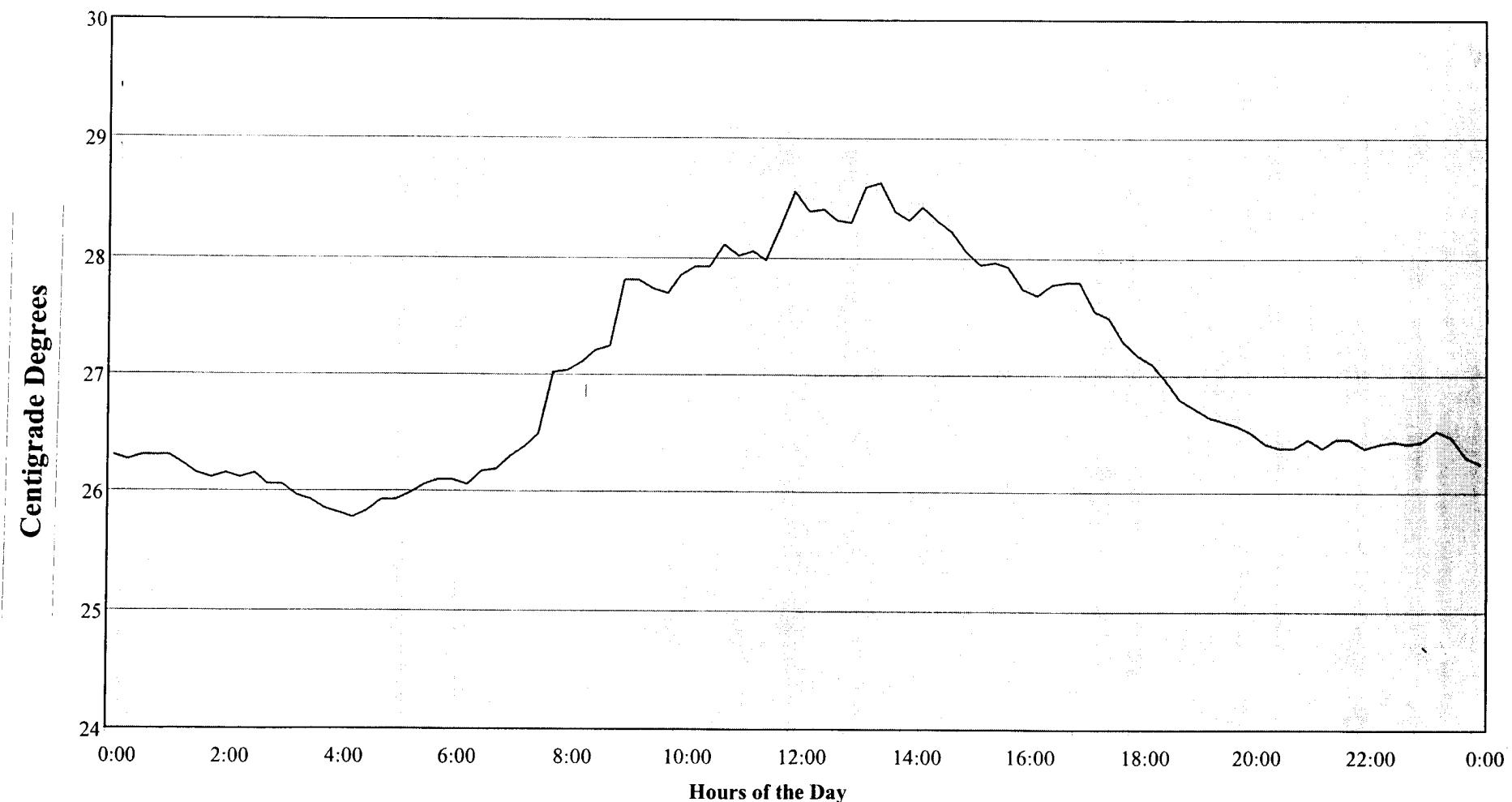
5 0 5 Km

SCALE 1:250,000

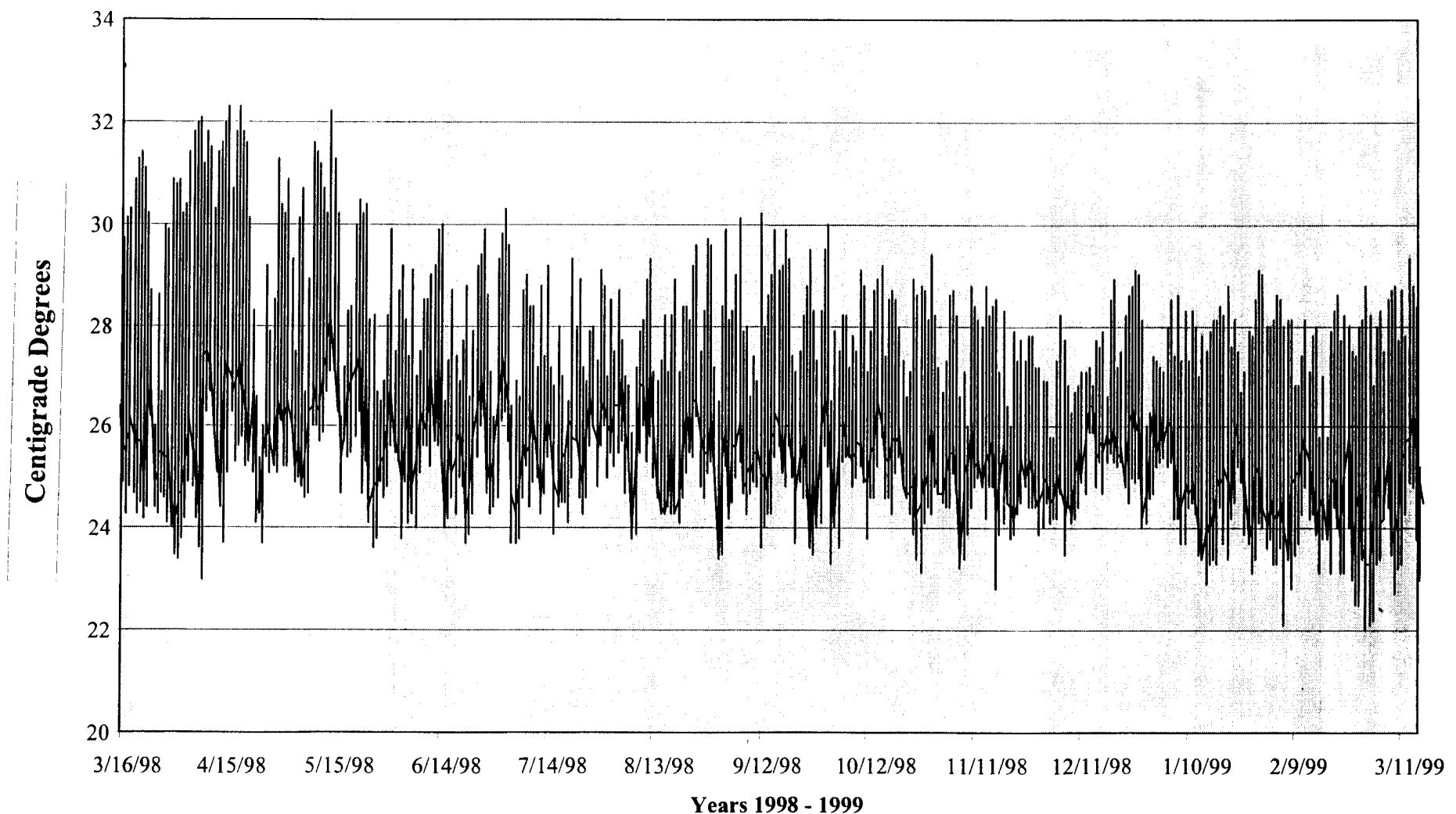
Hourly Temperature in Fort Sherman in centigrade degrees.
Period: March 16, 1998 – March 15, 1999



**Daily Evolution of the Temperature in Fort Sherman, Province of Colon.
June 11, 1998**



Hourly Temperature in Barro Colorado Island in centigrade degrees
Period: March 16, 1998 – March 15, 1999



Daily Evolution of the Temperature in Barro Colorado Island
June 11, 1998

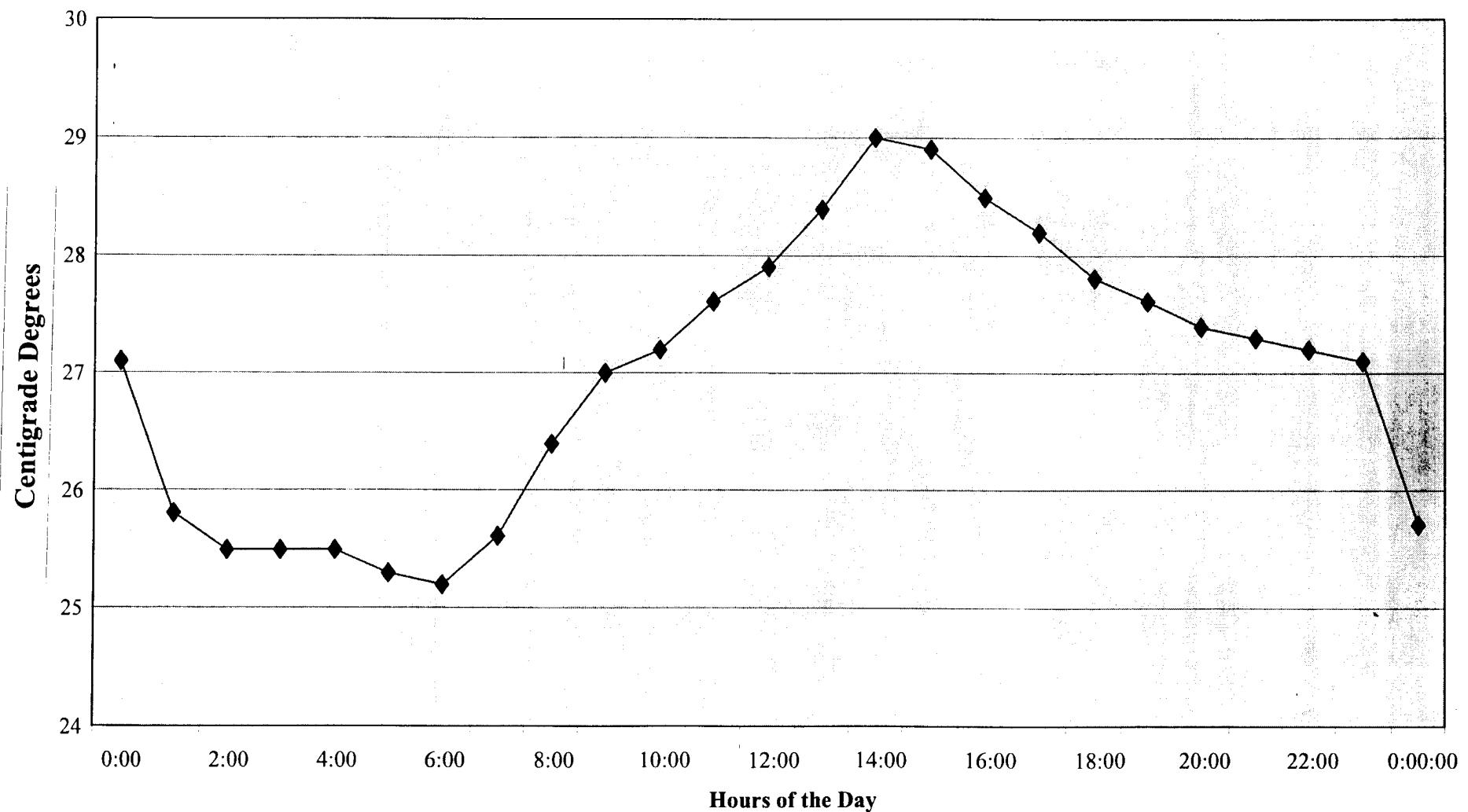


Table 1:
Summary of results obtained by the runoff model and its comparison to average registered rivers and extrapolated to the stopping points in the three options Indio, Caño Sucio y Toabré

River	Reported		Calculated by Model based on Life Zones – Forest Coverage						
	MMC/YEAR	MCS	MMC/YEAR	MCS	Comparison	MMC/YEAR	MCS	Comparison	
Indio	813.63	25.80	804.54	25.51	98.88%	786.30	24.93	96.64%	
Caño									
Sucio	233.37	7.40	184.37	5.85	79.00%	177.22	5.62	75.94%	
Toabré	1,286.67	40.80	1,112.51	35.28	86.46%	1,058.00	33.55	82.23%	
TOTAL	2,333.66	74.00	2,101.42	66.64	90.05%	2,021.52	64.10	86.62%	

River	Reported		Calculated by Model based on Life Zones – Current Land Use						
	MMC/YEAR	MCS	MMC/YEAR	MCS	Comparison	MMC/YEAR	MCS	Comparison	
Indio	813.63	25.80	880.39	27.92	108.21%	858.05	27.21	105.46%	
Caño									
Sucio	233.37	7.40	239.70	7.60	102.71%	216.62	6.87	92.82%	
Toabré	1,286.67	40.80	1,273.32	40.38	98.96%	1,250.62	39.66	97.20%	
TOTAL	2,333.66	74.00	2,393.41	75.89	102.56%	2,325.30	73.73	99.64%	

ANNEX 2-B

**Panama Canal
Proposal and Evaluation
Of
Upper Watershed Options
Letter Report**

By

URS

March 5, 2004

Table of Contents

BASIN PROPERTIES.....	2
TOABRE 1.....	4
TOABRE 2.....	5
INDIO 1	6
INDIO 2	7
INDIO 2B.....	8
TERIA 1	9
TERIA 2.....	11
NORTH GATUN OPTIONS.....	12
CIRI RIVER OPTIONS	13

Basin Options

Basin Properties

The following table provides a list of basin properties, including basin area, anticipated stage elevation, and associated storage.

Table 1. Sub-Basin Maximum Stage Properties

Name	Basin Area (km ²)	Design Stage Elevation (m)	Storage at Design Stage Elevation (millions of cubic meters)	Basin Bottom Elevation at Control Structure (m)	Main Control Structure Crest Width (m)	Required Structure Height (m)
Toabre 1	52	315	250	212	1,360	103
Toabre 2	30	500	450	318	1,340	182
Indio 1	12	310	150	217	855	93
Indio 2	56	480	800	286	1,330	194
Indio 2B	60.9	400	370	257	1,260	143
Teria 1	94.0	155	570	46	1,680	109
Teria 2	35.6	260	245	166	400	99

Table 2. Basin Sedimentation Properties

Basin Name	Basin Area (km ²)	Sediment Load (1.3 mm per year for 100 years) (millions of cubic meters)
Toabre 1 w/o 2	22	2.9
Toabre 1	52	6.8
Toabre 2	30	3.9
Indio 1 w/o 2	12	1.6
Indio 1	68	8.8
Indio 2	56	7.3
Indio 2B	60.9	7.9
Teria 1 w/o 2	58.4	7.6
Teria 1	94	12.2
Teria 2	35.6	4.6

Table 3. Viable Option Basin Properties

Option	Basin Area (km ²)	Design Stage Elevation (m)	Design Max Drain Elevation (m)	Max Storage at Design Stage Elevation MCM	Usable Storage at Design Stage Elevation MCM	Estimated Mean Annual Discharge MCM/yr	Mean Annual Runoff (m/yr)	Residence Time (yr)
A. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
A. Teria 2	35.6	265	225	245	200	105.6	2.97	1.89
Total A	94.0	N/A	N/A	515	420	233.8	2.49	1.80
B. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
B. Teria 2	35.6	265	220	245	210	105.6	2.97	1.99
B. Indio 2B	60.9	300	295	30	20	203.2	3.34	0.10
Total B	154.9	695	N/A	545	450	437.0	2.82	1.03

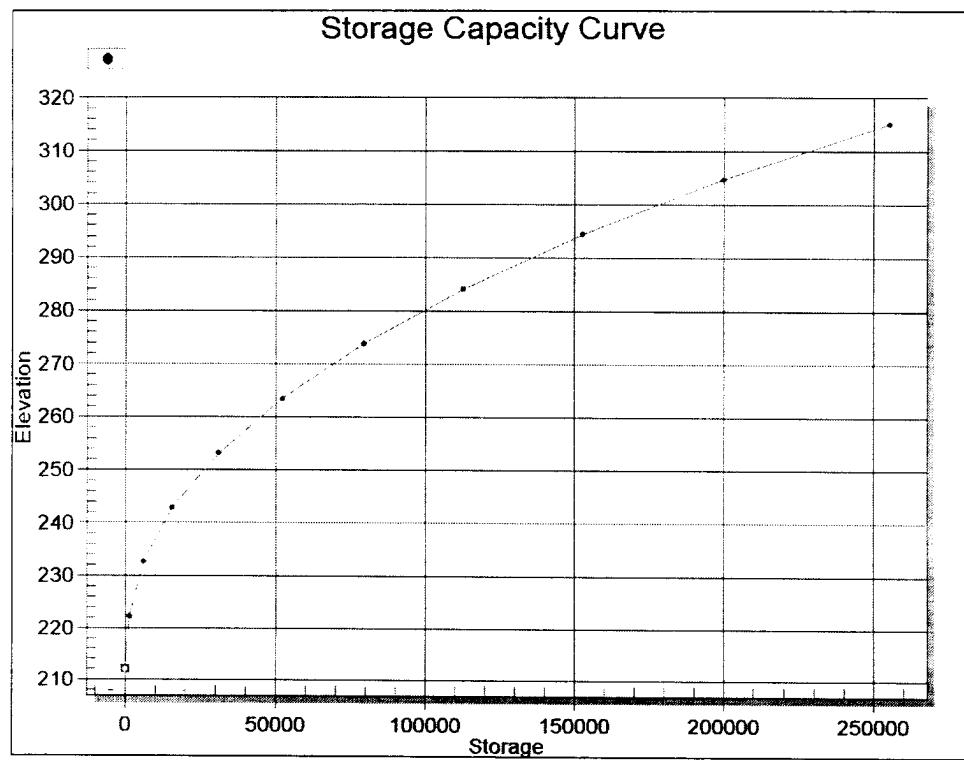
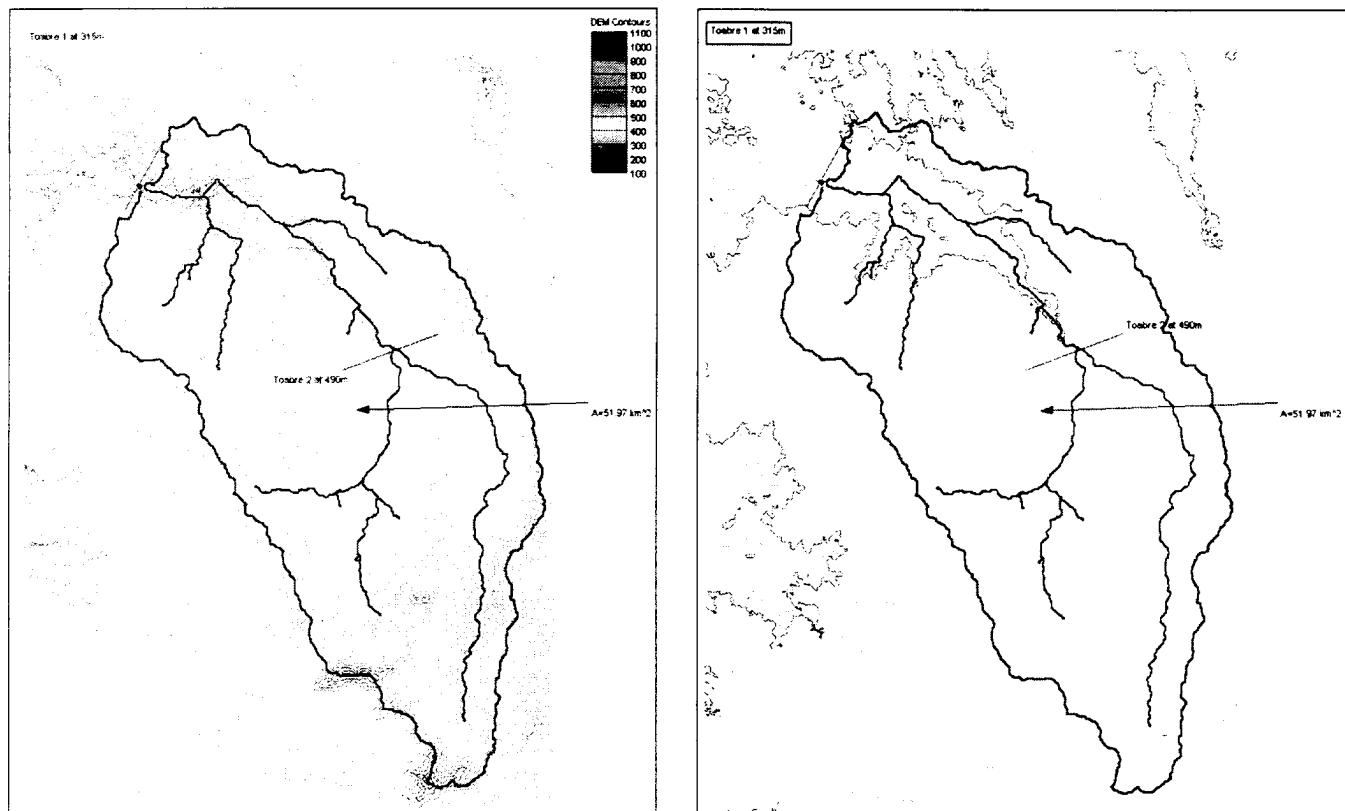
MCM: Million of Cubic Meters

Working Options:

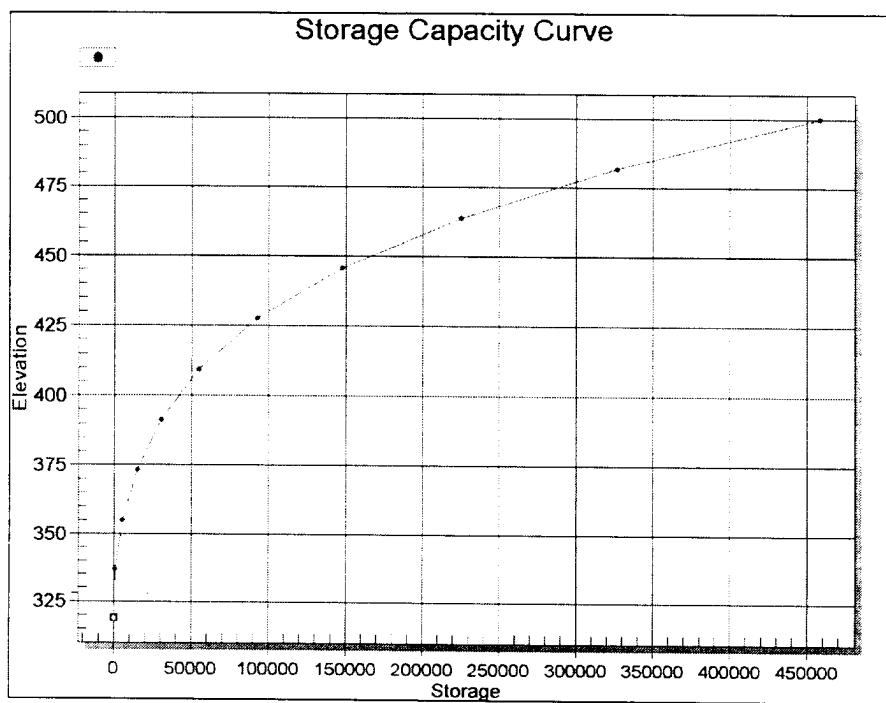
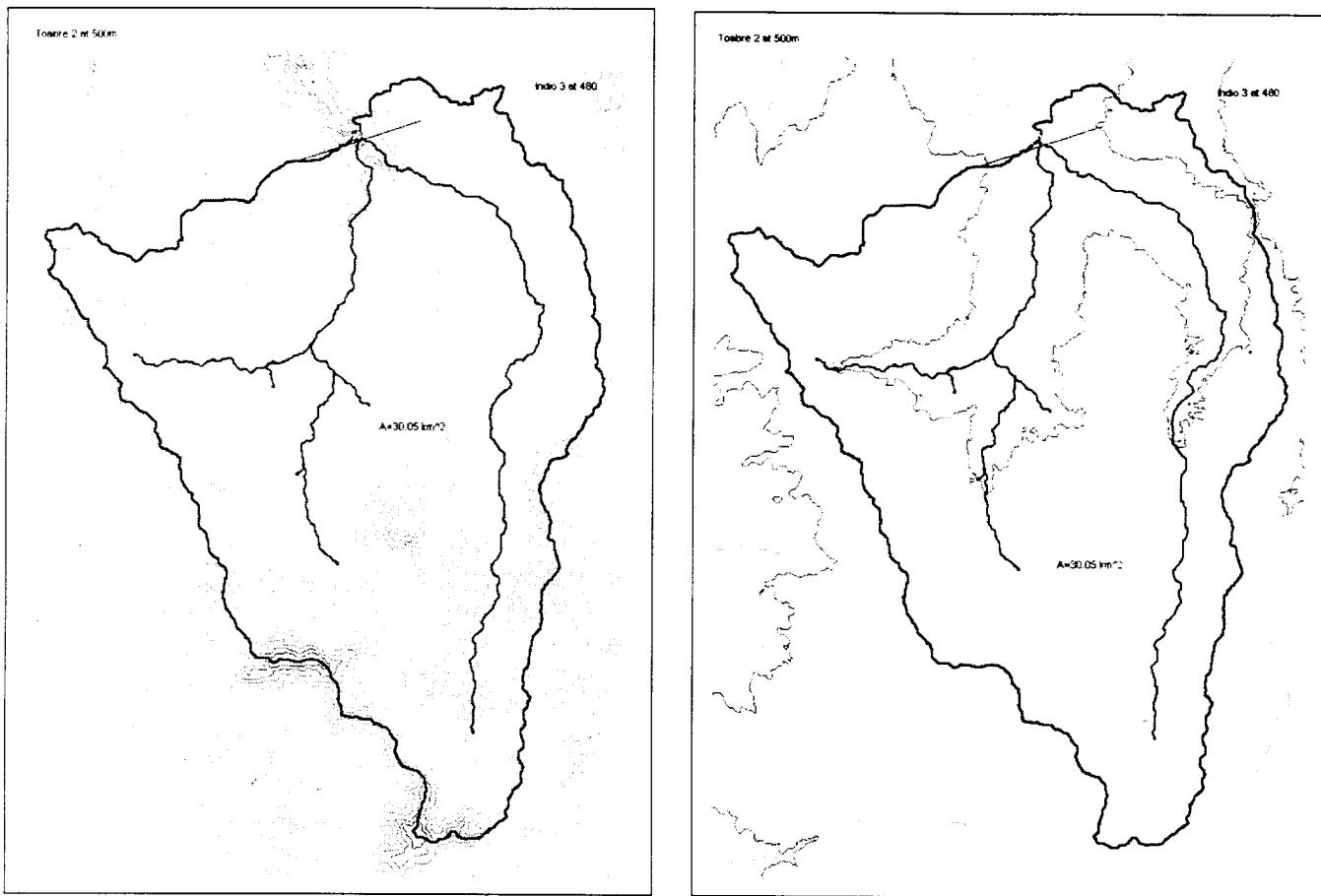
A: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 130m, draining to 90m, generating 220mcm of usable storage and replenishing every 1.71 years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.77 years on average, with a max total storage of 815mcm.

B: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

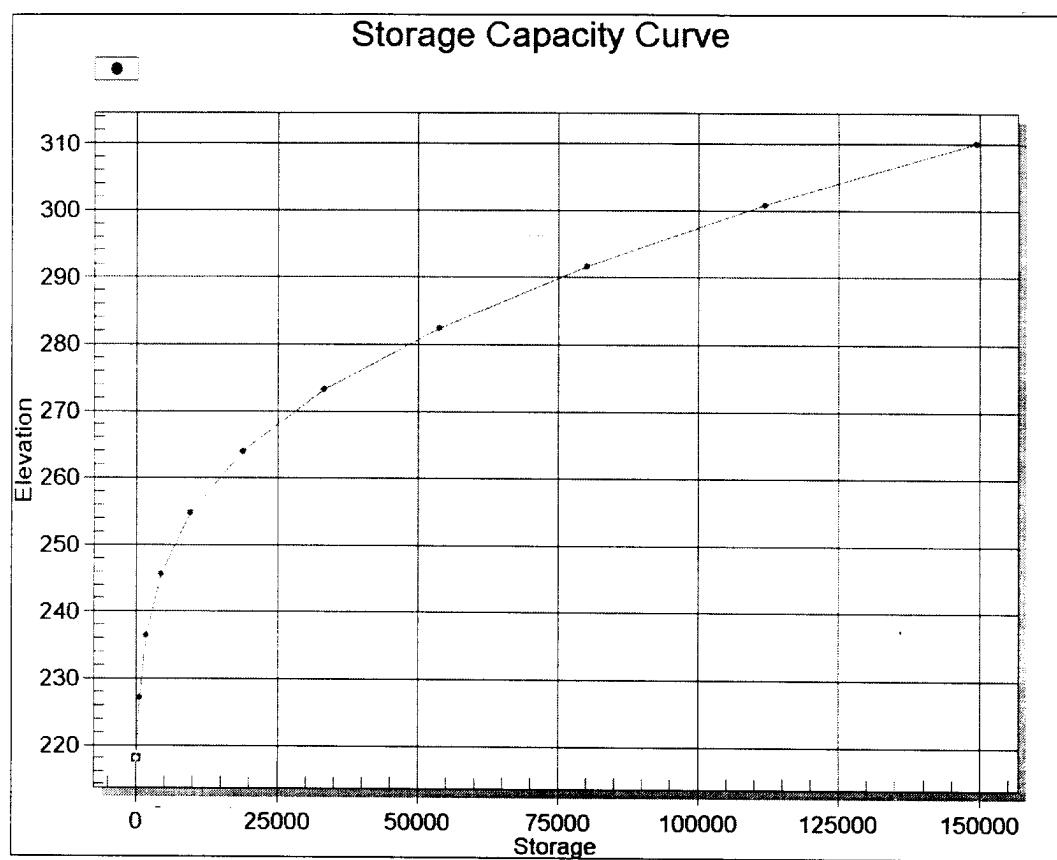
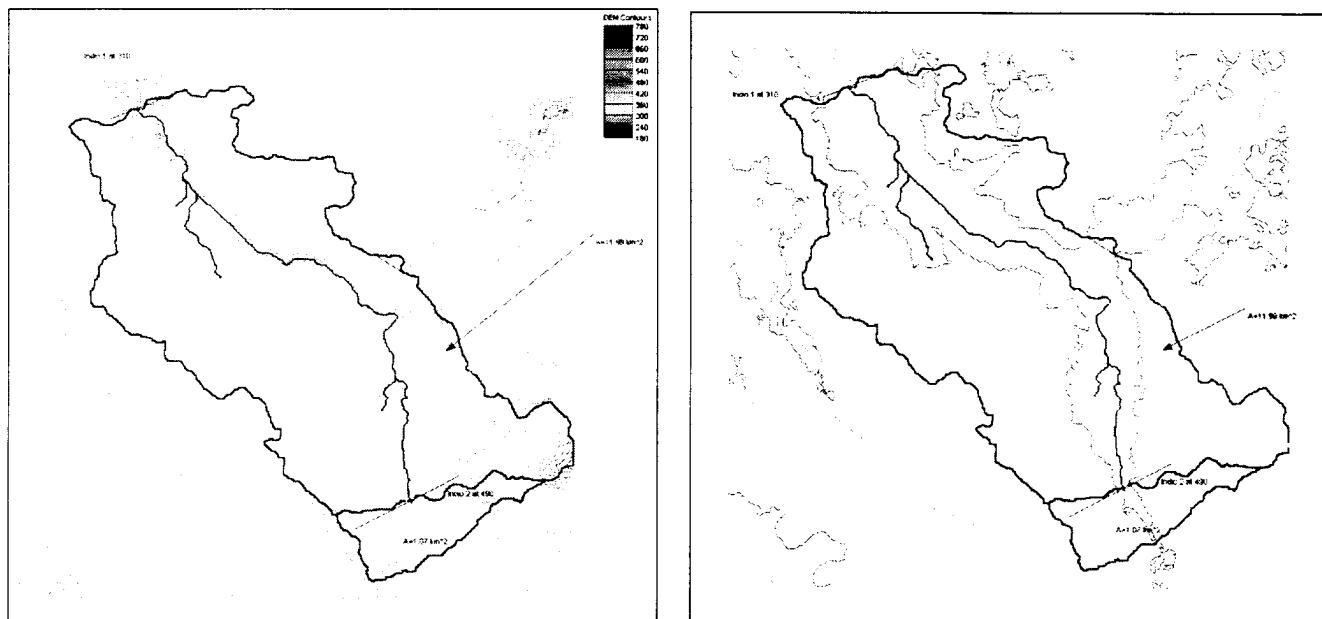
Toabre 1



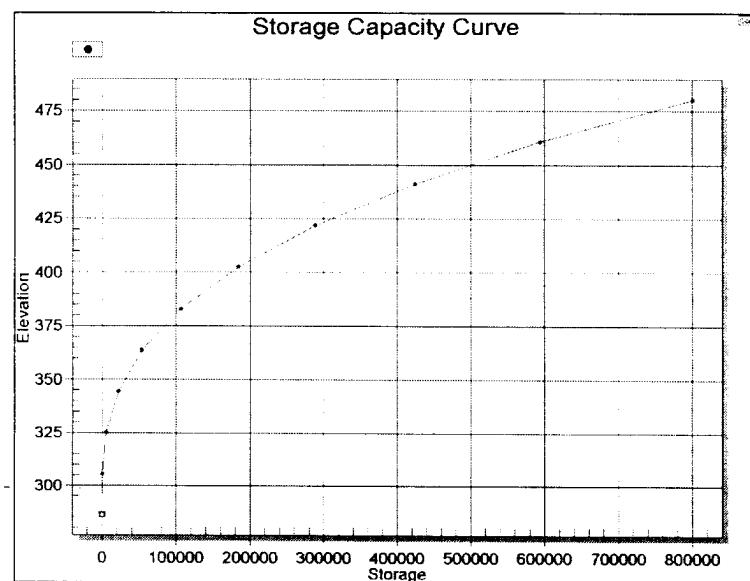
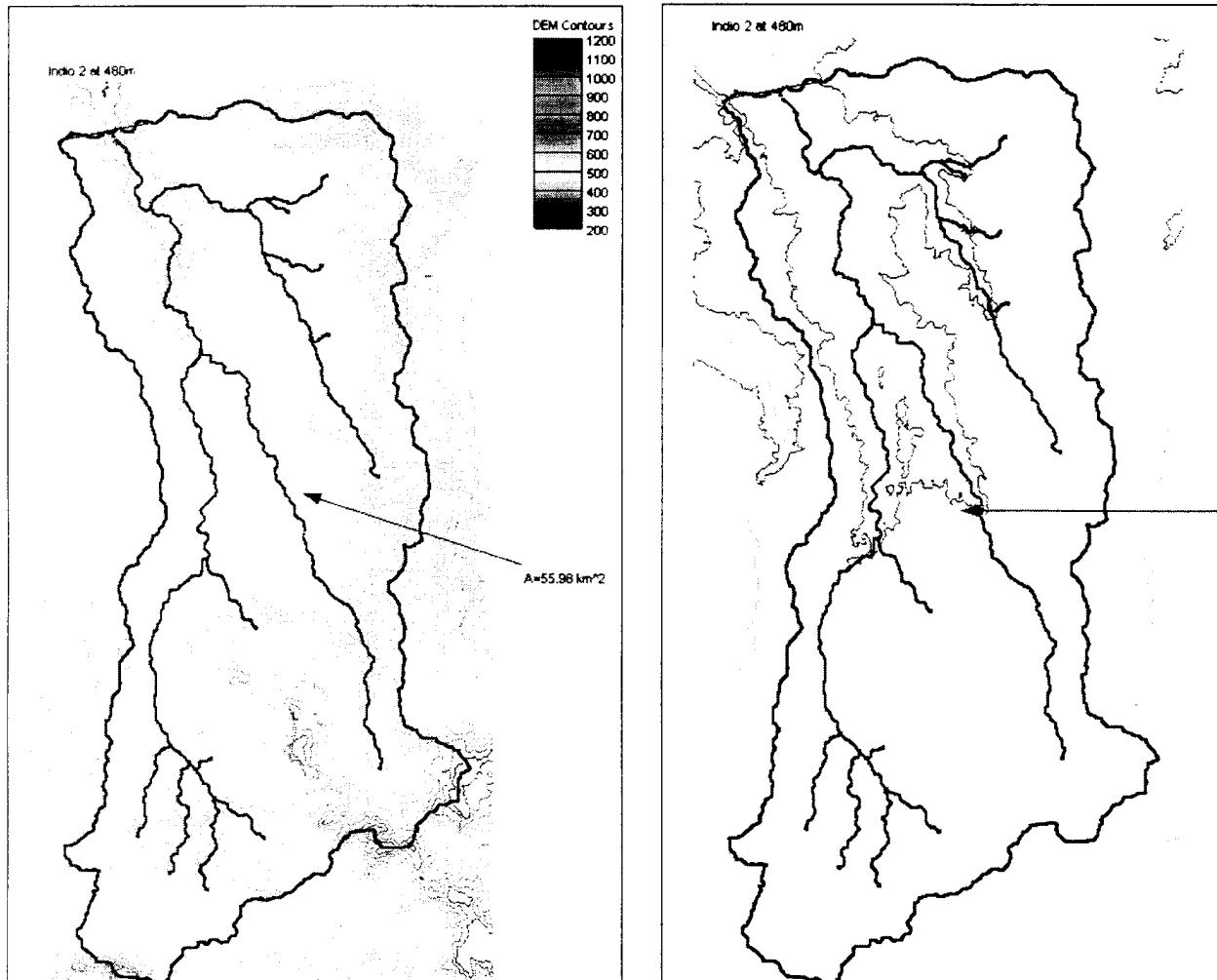
Toabre 2



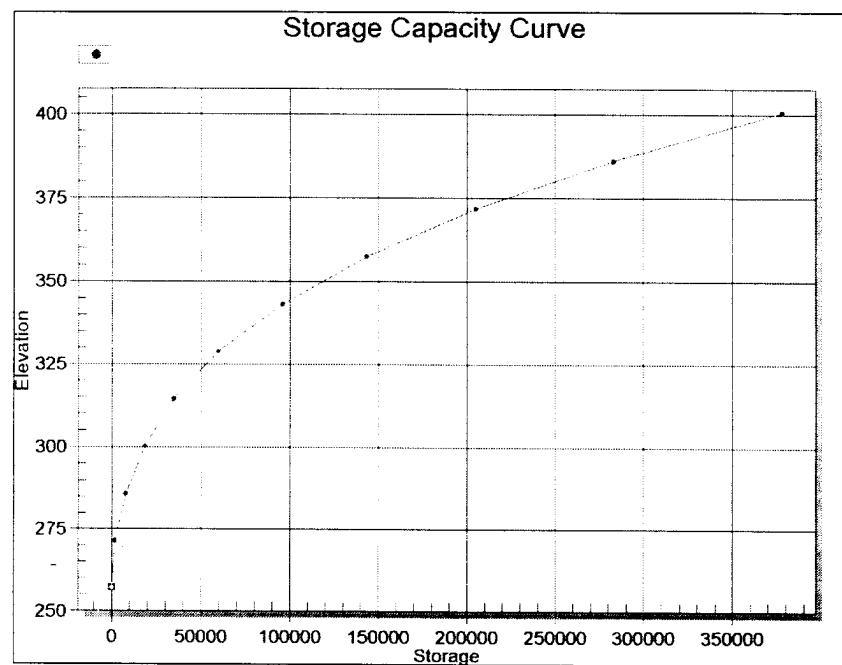
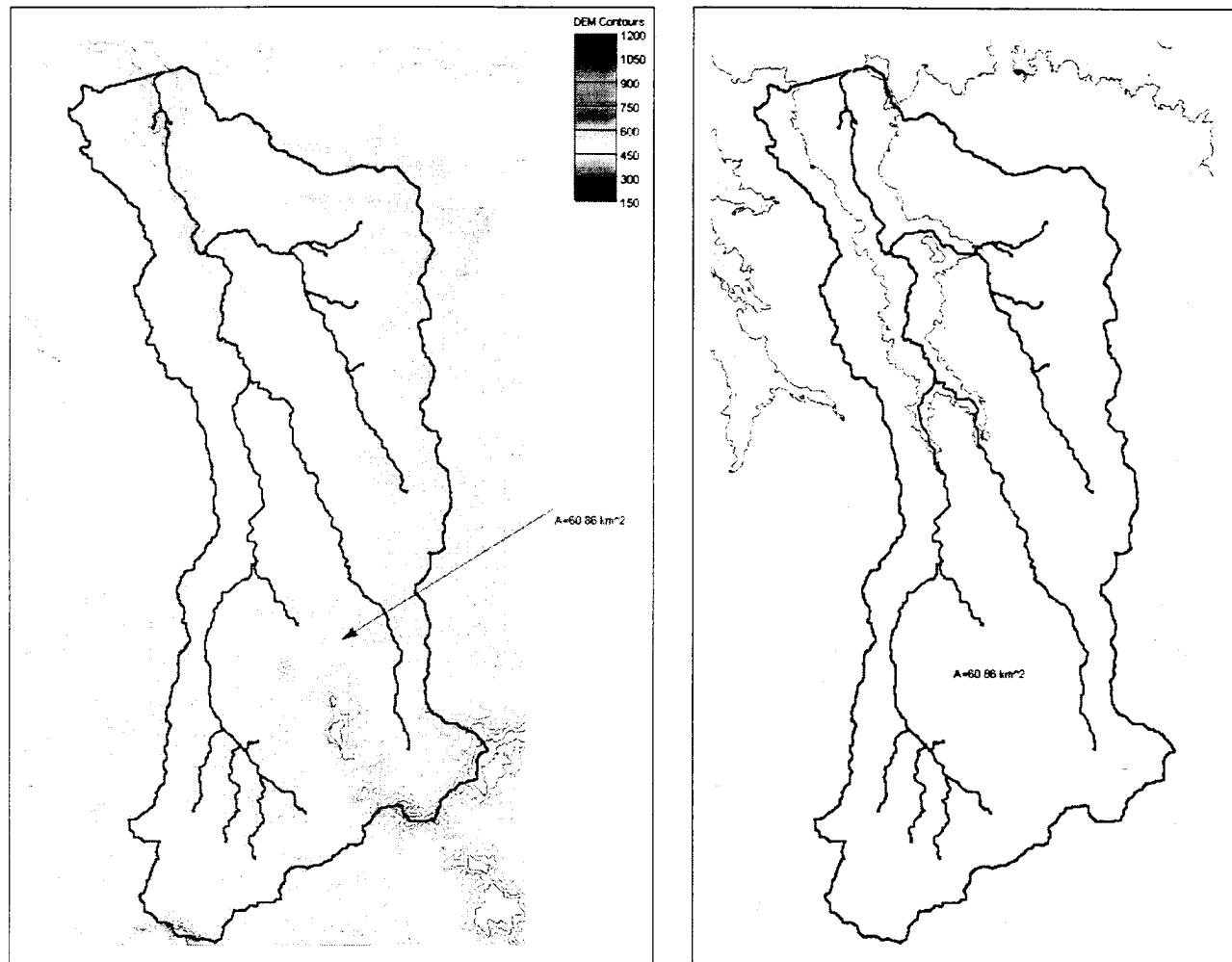
Indio 1



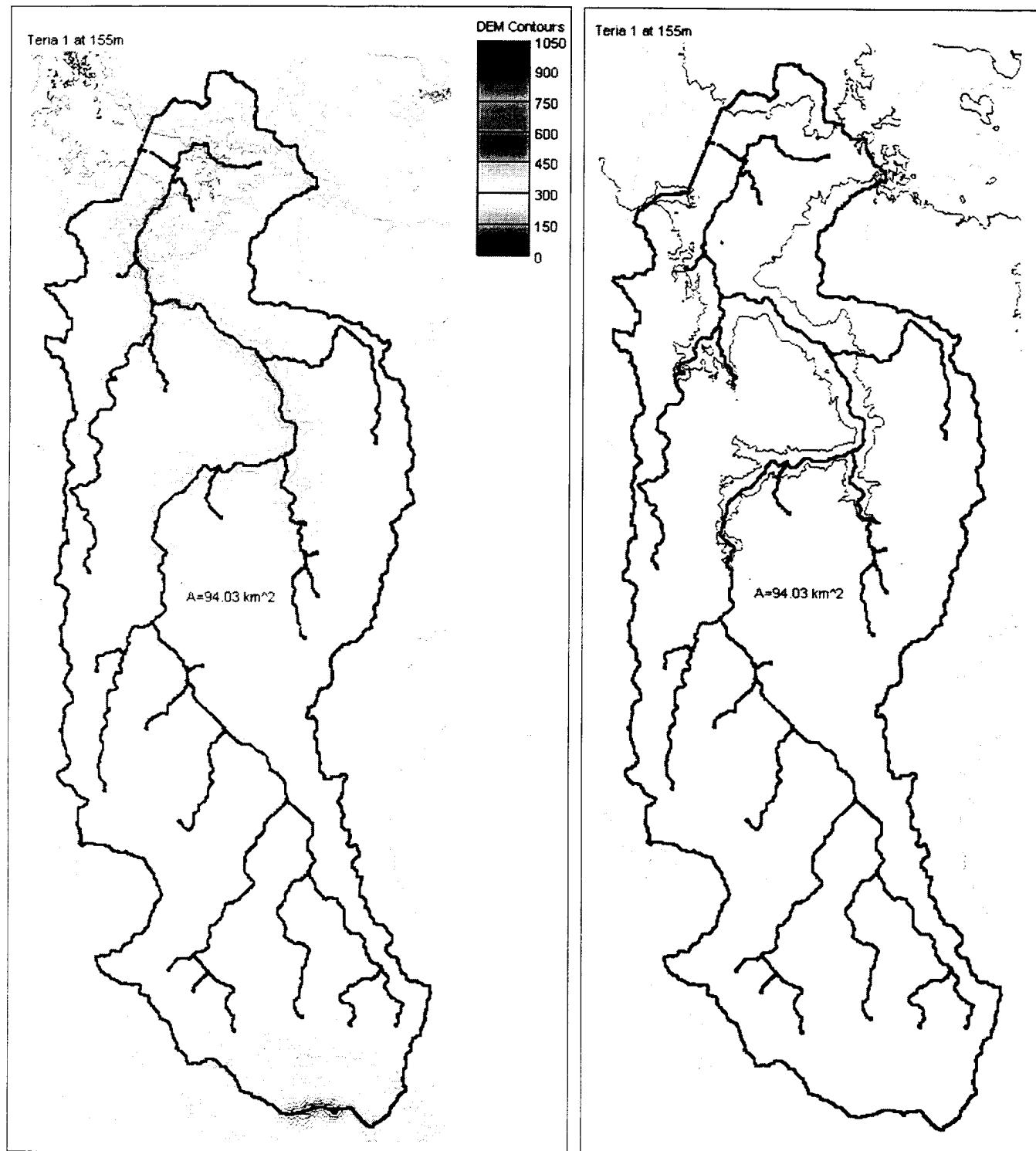
Indio 2

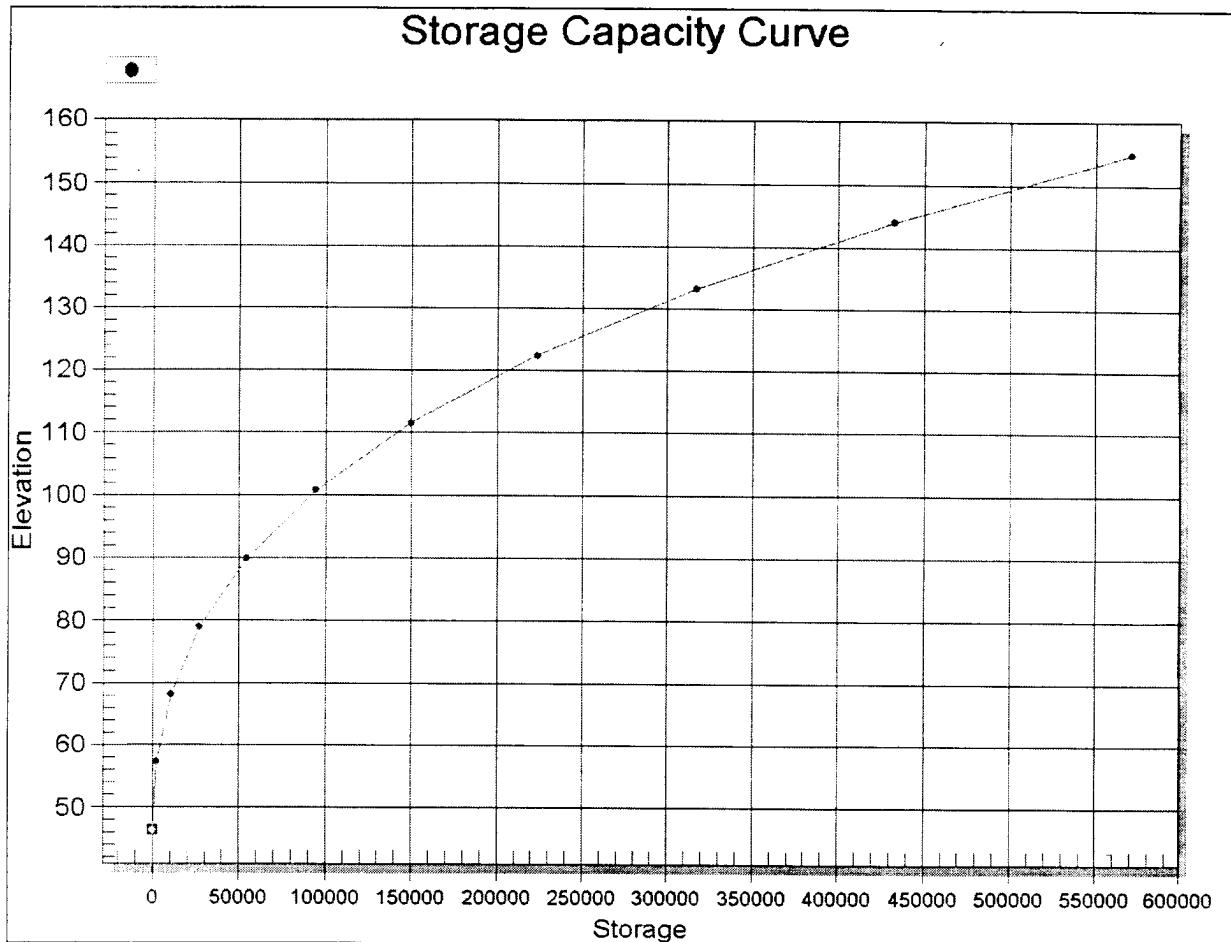


Indio 2B

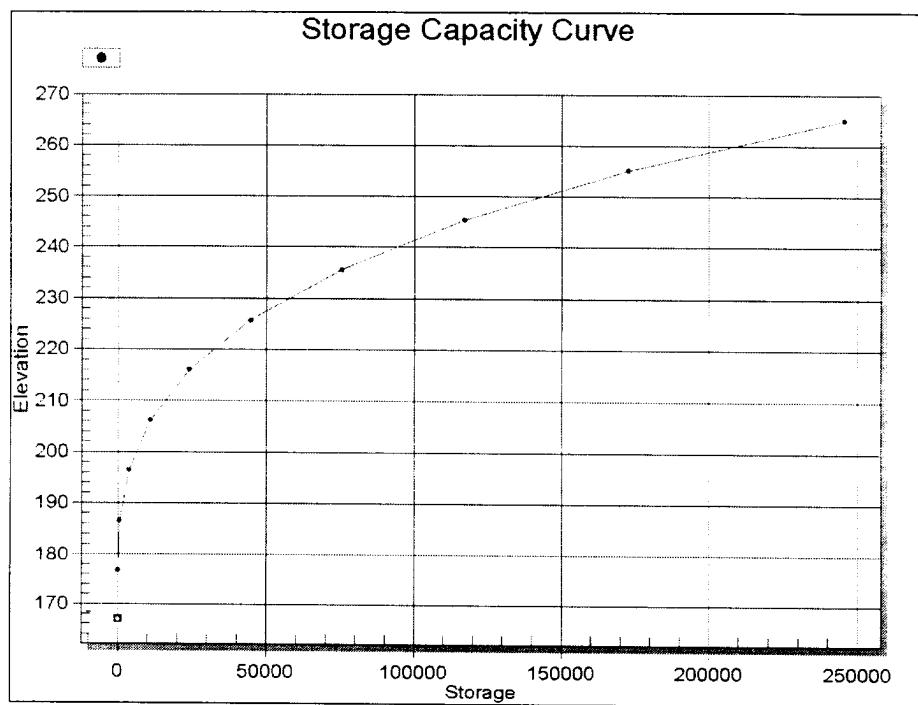
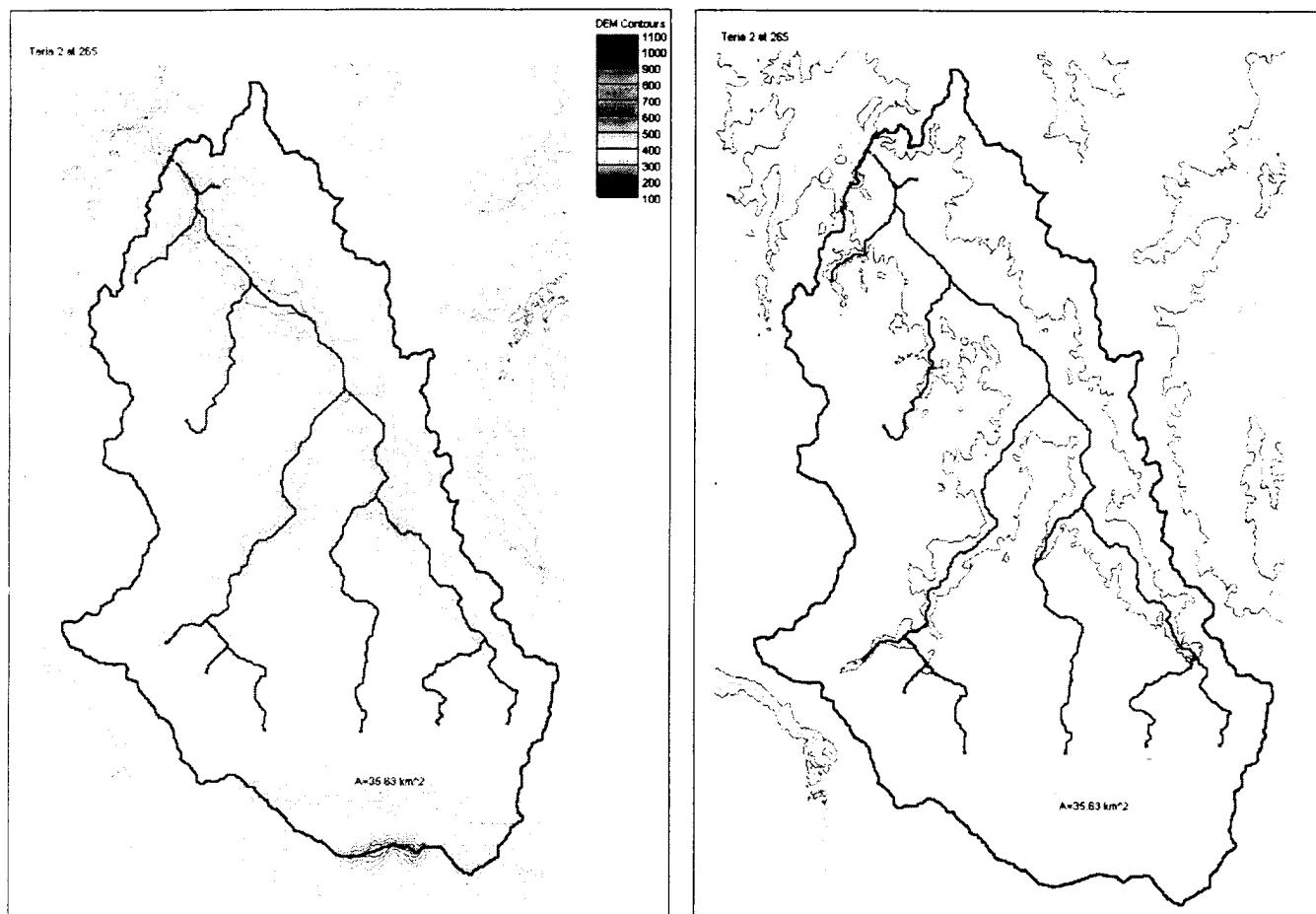


Teria 1

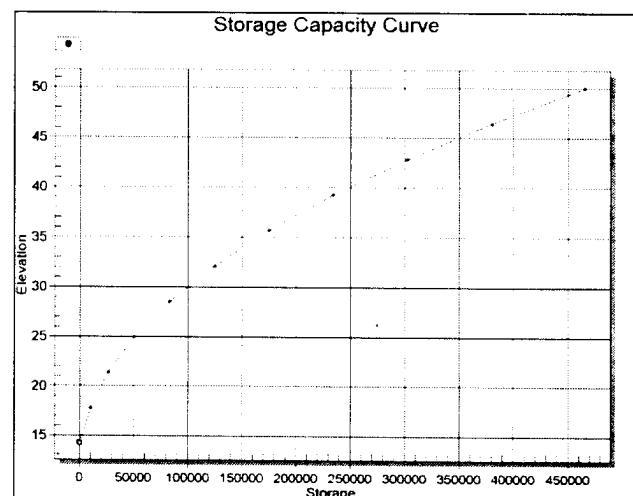
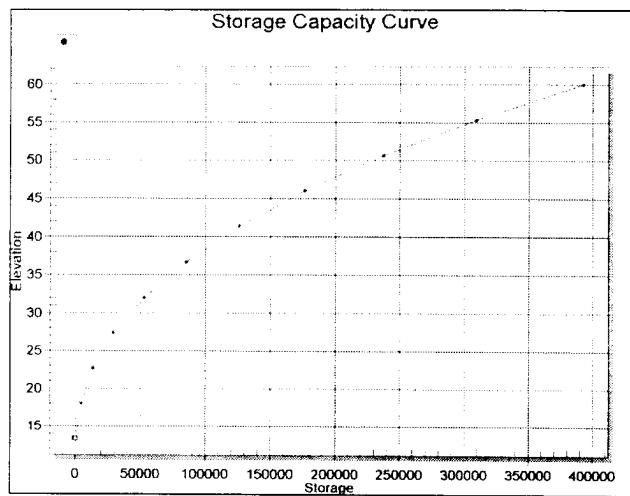
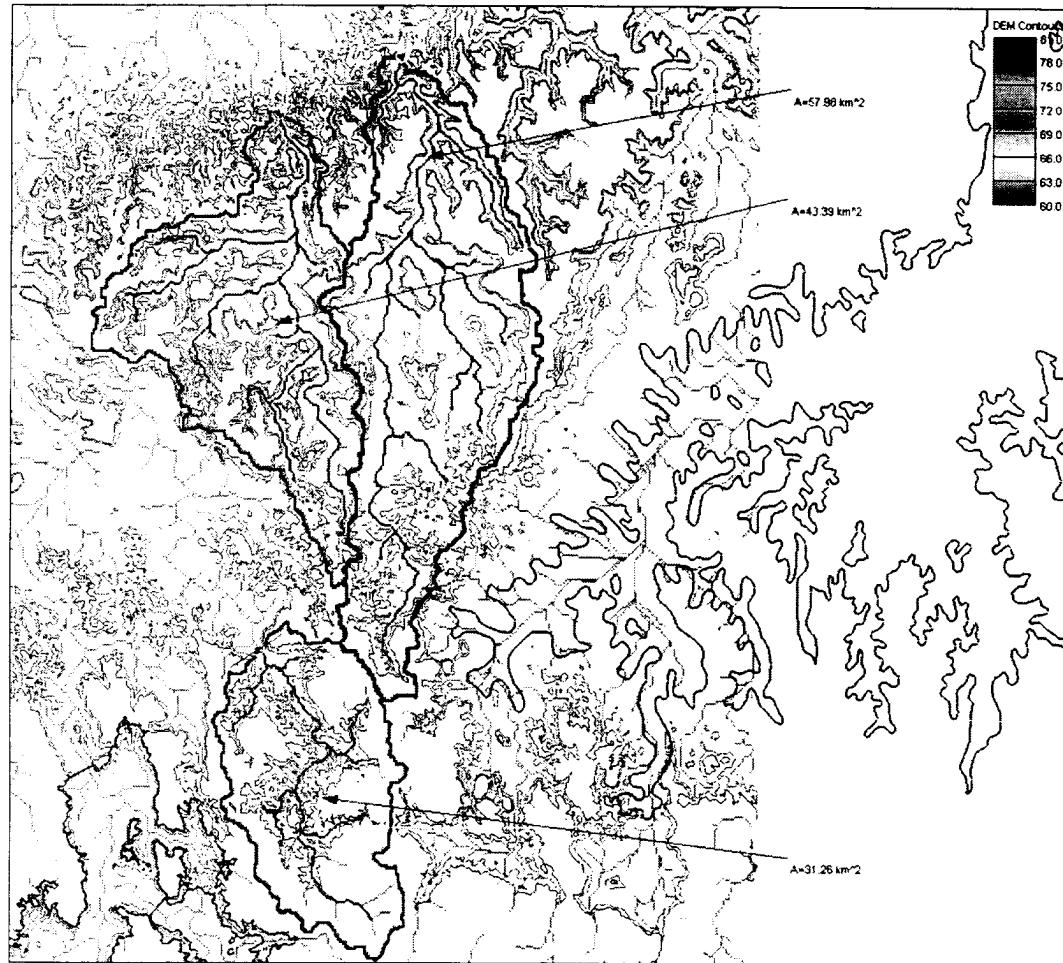




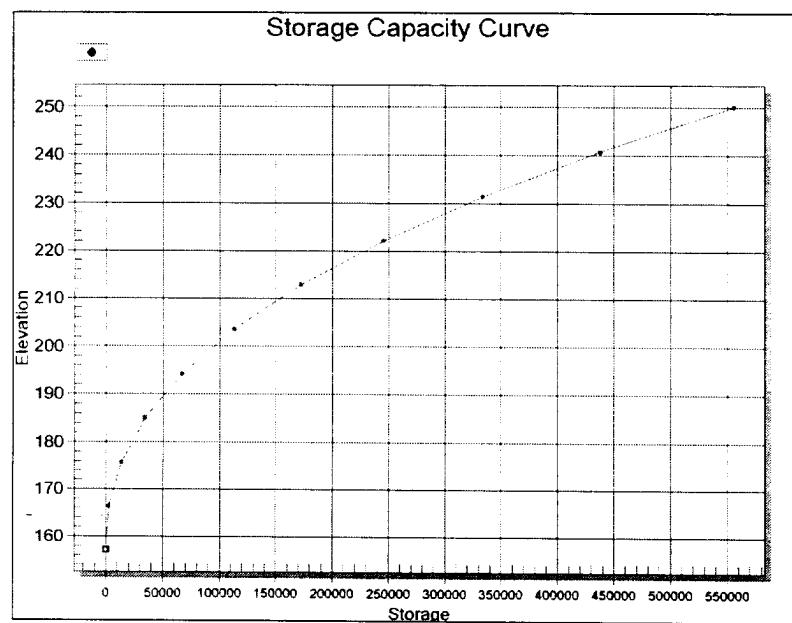
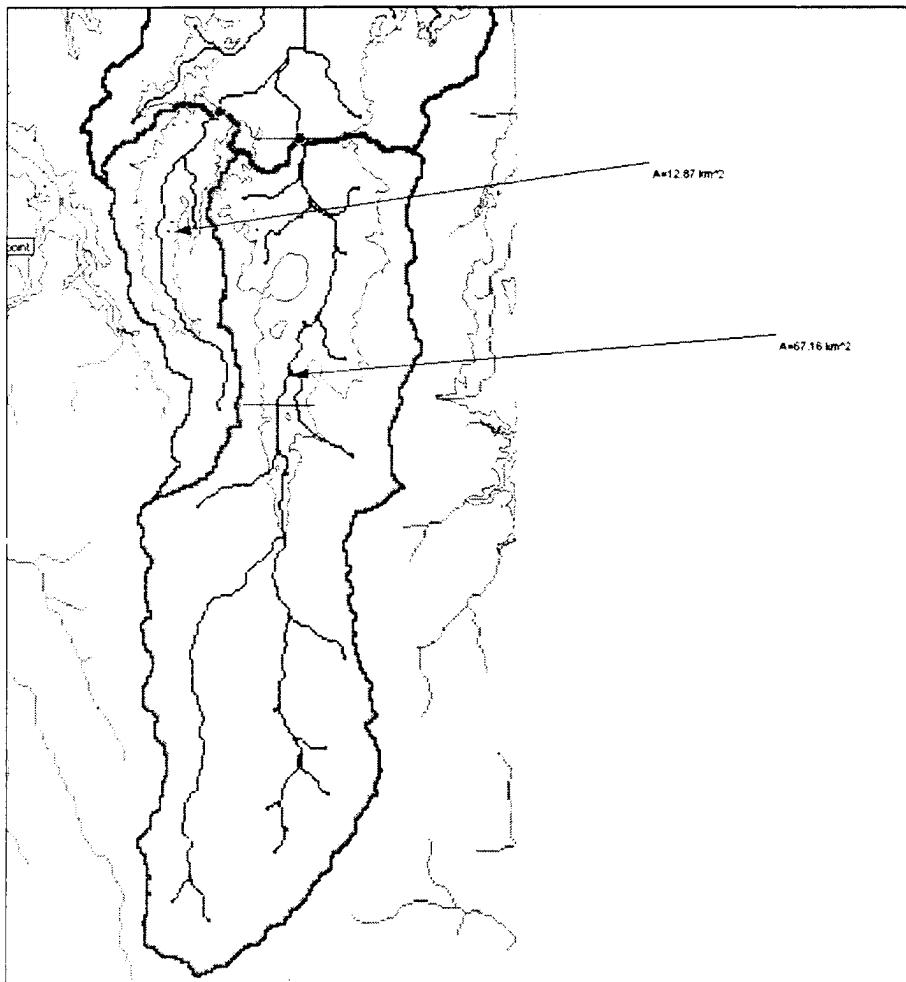
Teria 2



North Gatun Options



Ciri River Options



ANNEX 2-C

Conceptual Level Cost Estimate for URS Alternatives 11 and 12
Panama Canal Water Supply Options Environmental Assessment
By: Nicole Hunter and Sal Todaro (URS Denver)
Date: February 13- March 1, 2004

The following report provides preliminary cost estimates for Teria 1, Teria 2 and Indio 2B dams and appurtenant work, as well as the combined cost for Options 11 and 12. Costs are based on the Rio Indio Water Supply Project supplied by MWH/TAMS. Table 1 summarizes dam properties for comparison purposes in the cost estimate. Graphically the profiles are included in Attachment 1

Table 1 Dam Properties

Location	Initial Structure Height (m)	Crest Length (m)	Rockfill Shell Volume (million m ³)
Rio Indio	76		2.7
Teria 1	109	1,680	14.6
Teria 2	94	400	1.7
Indio 2B	143	1,260	16.2

An “all in” unit price of \$19.52/m was calculated for the main dam based on the volume of the rockfill shell and cost of the Rio Indio dam. This includes the concrete face slab, fill, silty sand, filter fine rockfill, rockfill and coarse rockfill. This cost was proportioned using corresponding rockfill volumes for the Teria 1, Teria 2, and Indio 2B dams. The Rio Indio cross-section was used for all three dams. Assumed depth to top of rock was assumed to be 4-meters for all cases. Dam quantities were calculated using average end areas. Heights and lengths were taken from the All Dam Profile Data Values spreadsheet provided. Quantities were determined based on these profiles. Sections were cut approximately every 100 feet for Teria 1 and Indio 2B, and approximately every 50 feet for Teria 2. Maximum sections were also calculated for each. Refer to attached spreadsheets. Refer to the dam quantities spreadsheets for details.

Saddle dams were sized using a cross section for an earthfill dam from Rio Indio. The Rio Indio saddle dams were assumed to be the same size and estimated to be approximately 840,000 cubic meters. The cross section was assumed to be the same for all saddle dams at Teria 1 and 2. Lengths and heights of the dam embankment were estimated from the All Dam Profile Data Values spreadsheet provided. Quantities were calculated in the same way as the main dam quantities. The cost estimate includes two saddle dams at Teria 2 and three saddle dams at Teria

1. It was assumed that the cost provided for Rio Indio included two saddle dams. The all in price per cubic meter of saddle dam was \$4.42. Refer to saddle dam spreadsheets for details.

The dimensions of the interbasin water transfer tunnel (Teria 1 to Ciri o Ciricio River) to be used in both Options 11 and 12 were assumed to be the same as the Rio Indio transfer tunnel. The length of the tunnel is approximately 4km. This is about half the distance of the Rio Indio, and therefore approximately half the price. The cost of a canal transferring water from the Indio 2B reservoir to the Teria River basin was also included. This was estimated based on the cost of canals for the Caño Sucio and Toabré projects considering differences in canal length and cross section.

Value of the land was estimated to be \$1,000/ha according to the ACP for the Rio Indio area. This same value was applied to Teria 1, Teria 2 and Indio 2B for land acquisition costs. Land acquisition includes the reservoir area plus a 20 percent increase to account for borrow areas, construction roads, structures, disposal areas, construction camp and other temporary construction. Reservoir and basin areas are summarized in Table 2 below. Resettlement costs were not accounted for in the estimate. These areas are thought to have few inhabitants. General costs were calculated using the ratio of the land acquisition cost to the general costs of Rio Indio.

Table 2 – Reservoir Values

Location	Reservoir Area (km ²)	Basin Area (km ²)
Rio Indio	45.6	381
Teria 1	13.76	94.0
Teria 2	8.24	35.6
Indio 2B	7.26	60.9

Diversion and spillway costs were estimated using the ratios of the peak PMF for each dam compared to the Rio Indio peak PMF. Peak PMF was calculated for Teria 1, Teria 2, and Indio 2B and is summarized in Table 3. There is no information available on the 50-year flood for the Teria and Indio areas, so the area of the diversion tunnel was computed using the area of the Rio Indio tunnel times a ratio of the peak PMF inflows. A minimum finished diameter of 2.5 m was used. The cost of the spillway and diversion was estimated using the ratios of the peak PMF for each case compared to the Rio Indio spillway cost.

Table 3 – Peak PMF Values

Location	Catchment Area (km²)	PMF Peak (m³/s)
Rio Indio	381	4,345
Teria 1	94.0	2,450
Teria 2	35.6	1,600
Indio 2B	60.9	2,000

The cost for the low-level outlet works, minimum release facility and operation facilities were assumed to be the similar to the Rio Indio project, and therefore the same price. It is assumed that the minimum release facility will be at a similar depth below the crest.

A contingency of 30 percent was added to these estimates versus the 17 percent contingency on Rio Indio because of the greater number of uncertainties associated with the preliminary estimates. An engineering and administration fee of 15-percent was added to the cost of each of the dams, which is similar to that of the Rio Indio estimate.

Summary Costs for Options 11 and 12

Cost estimates were developed using costs and assumptions similar to those used for the MWH Rio Indio estimate so that project costs could be compared. Therefore, wherever possible, the Rio Indio cost estimate was used as a basis for these cost estimates.

Two options were prepared using this information. Option 11 consists of Teria 1 and Teria 2 and Option 12 consists of Teria 1 and Indio 2B. The option descriptions and associated costs as provided are presented below.

Option 11: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 155m, draining to 115m, generating just over 400mcm of usable storage and replenishing every 1.7-years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.7 years on average, with a max total storage of 815mcm.

Option 12: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria

watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

Table 4 provides a summary of the combined construction costs for the two options. Refer to Preliminary Cost Estimate Spreadsheet for details on the cost estimate for each of the three dams/reservoirs. The construction cost of the Rio Indio option by MWH/Tams is provided for comparison purposes. The table also includes the cost of each option per unit usable (live) storage.

Table 4 – Summary of Construction Costs

	RIO INDIO	OPTION 11	OPTION 12
Construction Cost (\$ M)	230	350	401
Usable Storage (MCM)	1,294	420	430
Unit Cost (\$/MCM)	177,743	833,333	932,558

Attachment 1: Control Structure Report

Table of Contents

BASIN PROPERTIES.....	6
INDIO 2B.....	7
TERIA 1	8
TERIA 2	9

Basin Options

Basin Properties

The following table provides a list of basin properties, including basin area, anticipated stage elevation, and associated storage.

Table 1. Viable Option Basin Properties

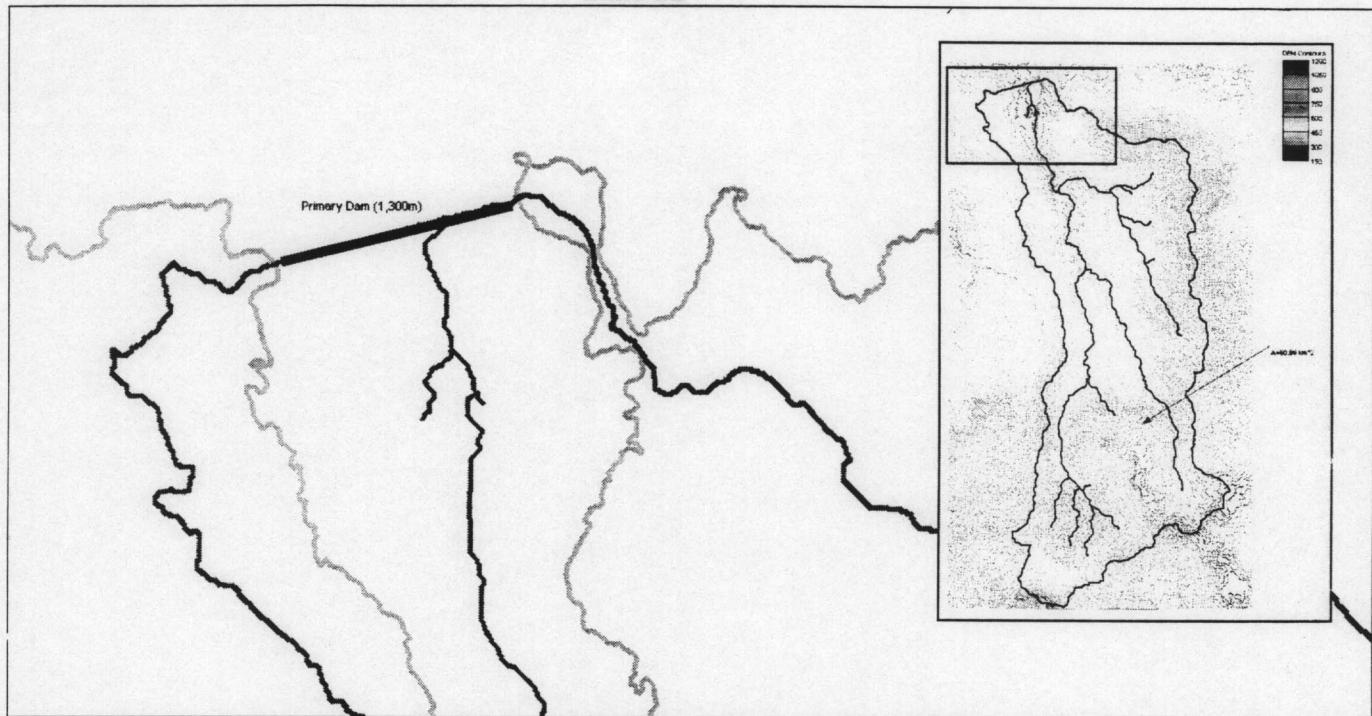
	(km ²)	(m)	(m)	MCM	MCM	MCM/yr	(m/yr)	(yr)
A. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
A. Teria 2	35.6	265	225	245	200	105.6	2.97	1.89
Total A	94.0	N/A	N/A	515	420	233.8	2.49	1.80
B. Teria 1	94.0	130	90	270	220	233.8	2.49	0.94
B. Teria 2	35.6	265	220	245	210	105.6	2.97	1.99
B. Indio 2B	60.9	300	295	30	20	203.2	3.34	0.10
Total B	154.9	695	N/A	545	450	437.0	2.82	1.03

Final Working Options:

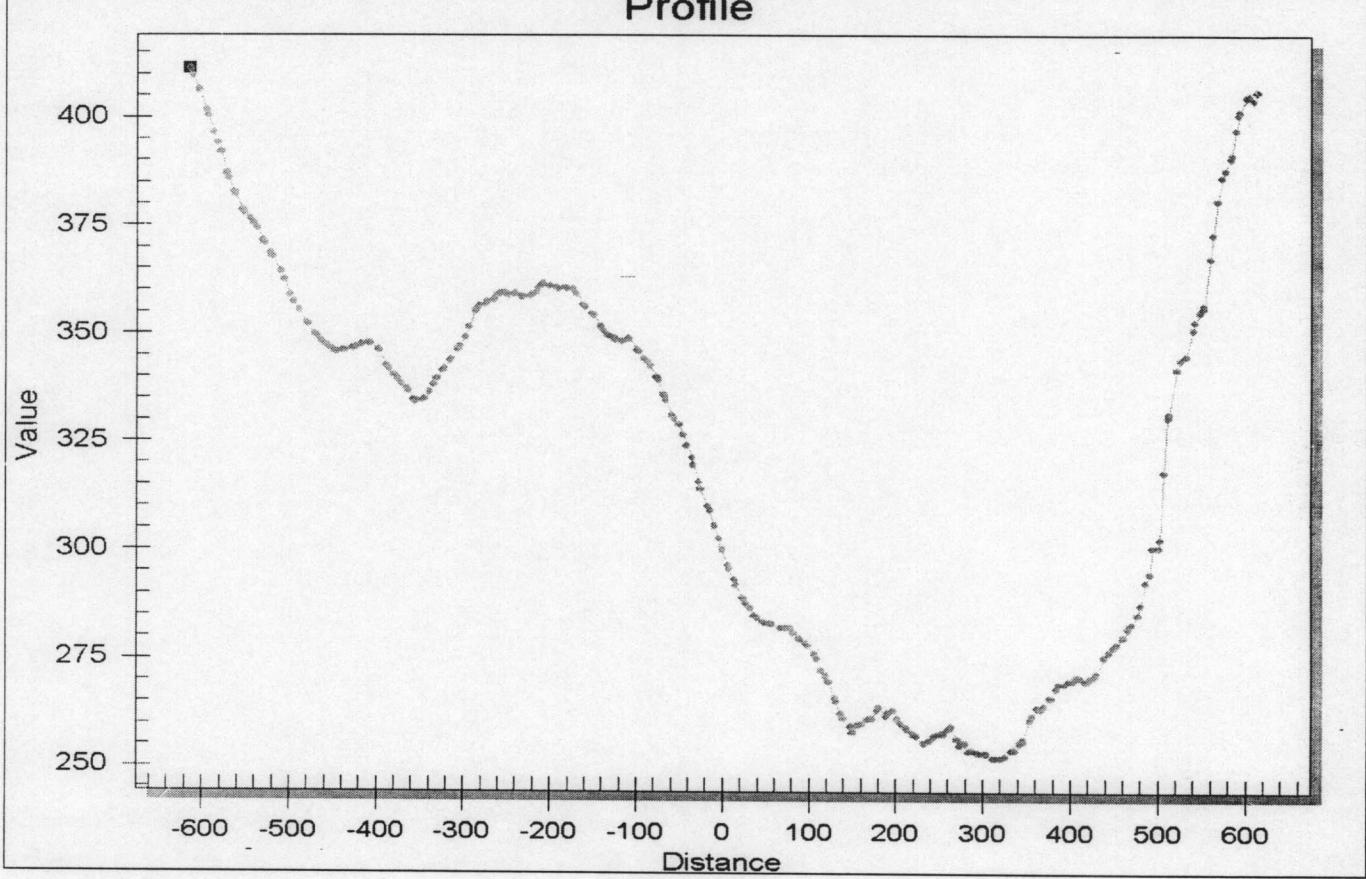
A: Teria 1 and Teria 2: Set Teria 1 to the max stage level of 155m, draining to 115m, generating just over 400mcm of usable storage and replenishing every 1.7-years. Set Teria 2 to a max stage of 265m; draining to 225m and generating 200mcm usable storage conveyed directly to Teria 1 via the existing river. Total usable storage will be 600mcm replenished every 1.7 years on average, with a max total storage of 815mcm.

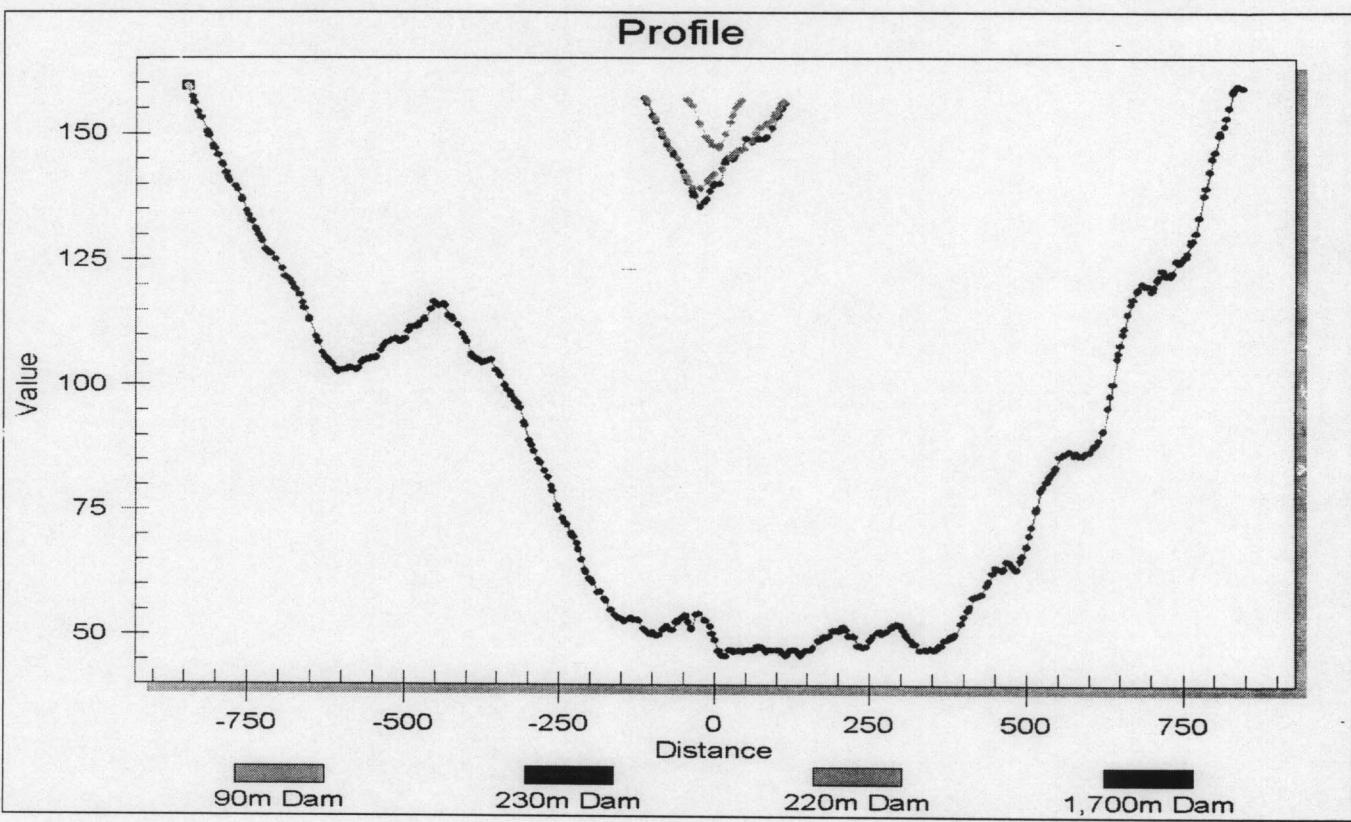
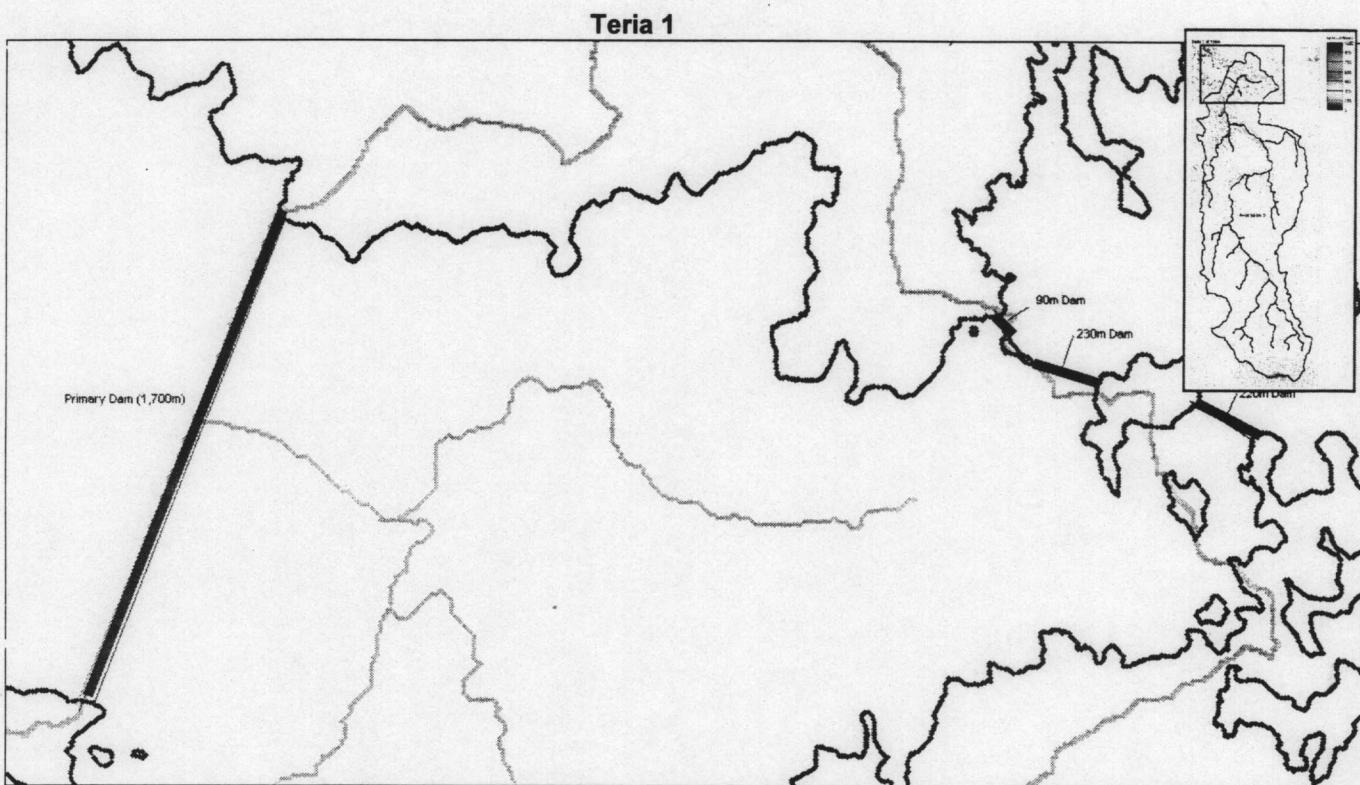
B: Teria 1 + Teria 2 and Indio 2B: Set Teria 1 to the max stage level of 130m, draining to 90m, generating just over 240MCM of usable storage and replenishing every 1.03 years. Set Teria 2 to a max stage of 265m; draining to 220m and generating 210mcm usable storage conveyed directly to Teria 1 via the existing river. Set Indio 2B to max stage of 300m, draining to 295m; generating 20mcm of usable storage conveyed via a 1km long aqueduct to Teria watershed. Total usable storage will be 450mcm replenished every 1.08 years on average, with a max total storage of 565mcm.

Indio 2B

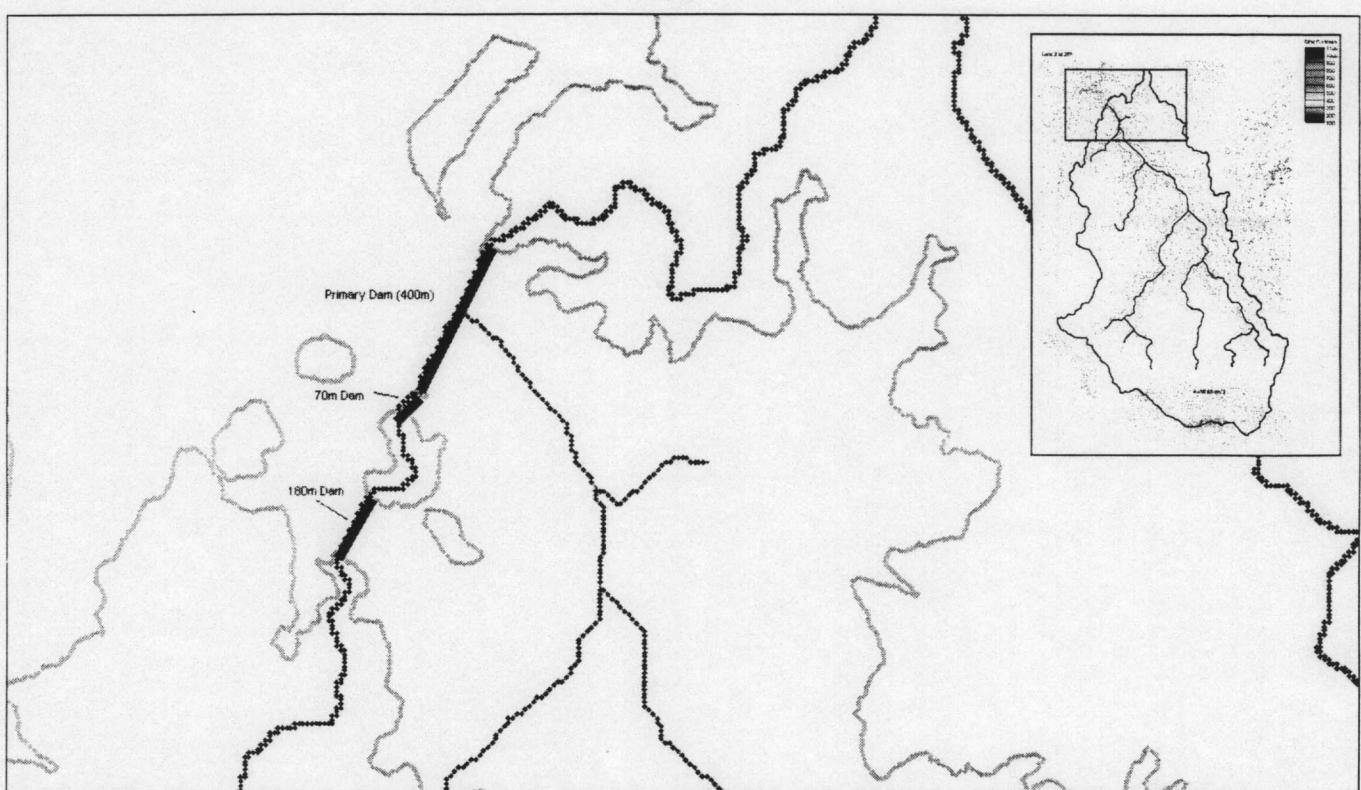


Profile

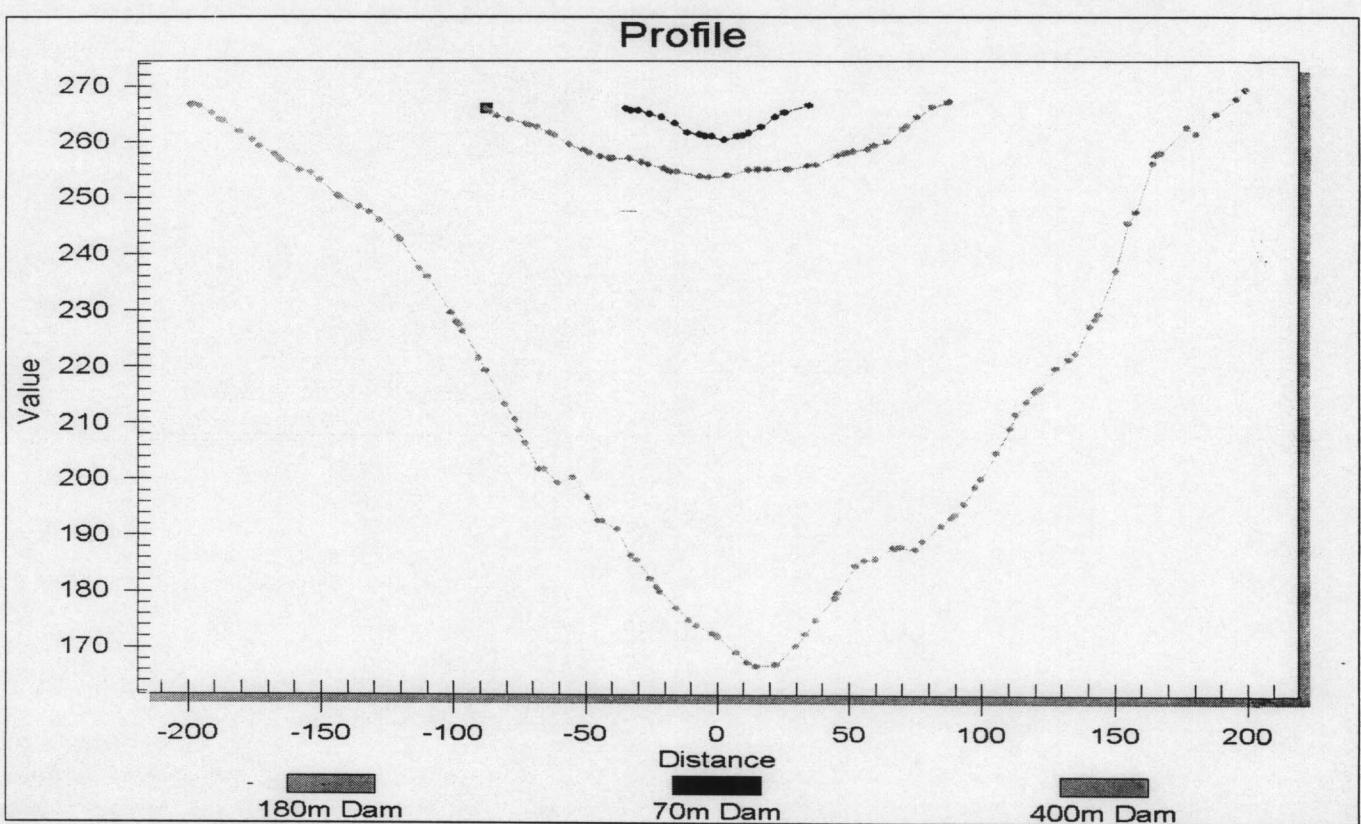




Teria 2



Profile



PRELIMINARY COST ESTIMATE

	Rio Indio	Teria 1	Teria 1 (145m)	Teria 1 (130m)	Teria 1 (115m)	Teria 2	Teria 2 (285m)	Indio 2B	Indio 2B (375m)	Indio 2B (360m)	Indio 2B (300m)
Volume of Rockfill Shell (m^3)	Vol = 2.7 million	Vol = 14.6 million	Vol = 11.2 mil	Vol = 7.3 mil	Vol = 4.5 mil	Vol = 1.7 million	Vol = 3.3 mil	Vol = 16.2 million	Vol = 8.7 mil	Vol = 6.2 mil	Vol = 1 mil
PMF (m^3/s)	PMF = 4,345	PMF = 2,450				PMF = 1,600	incl. 410 & 600	PMF = 2,000			
Estimated Cost											
Land Acquisition	\$ 6,100,000	\$ 1,651,200	\$ 1,651,200	\$ 1,651,200	\$ 1,651,200	\$ 988,800	\$ 988,800	\$ 871,200	\$ 871,200	\$ 871,200	\$ 871,200
Resettlement (2)	\$ 20,600,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
General Costs including Construction and Permanent Access (3)	\$ 23,839,000	6,452,943.74	6,452,944	6,452,944	6,452,944	3,864,263	3,864,263	3,404,678	3,404,678	3,404,678	3,404,678
Diversion (4)	\$ 3,803,000	2,437,933.26	2,437,933.26	2,437,933.26	2,437,933.26	1,592,119.68	1,592,119.68	1,990,149.60	1,990,149.60	1,990,149.60	1,990,149.60
Main Dam (5)	\$ 52,704,000	\$ 264,992,000	\$ 218,624,000	\$ 142,496,000	\$ 87,840,000	\$ 33,184,000	\$ 64,416,000	\$ 316,224,000	\$ 169,824,000	\$ 121,024,000	\$ 19,520,000
Spillway (6)	\$ 6,043,000	4,088,934.41	4,088,934.41	4,088,934.41	4,088,934.41	2,670,324.51	2,670,324.51	3,337,905.64	3,337,905.64	3,337,905.64	3,337,905.64
Low-level Outlet (7)	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000	\$ 3,049,000
Saddle Dams (8)	\$ 7,427,000	\$ 499,725	\$ 499,725	\$ 499,725	\$ 499,725	\$ 134,395	\$ 177,397	N/A	N/A	N/A	N/A
Interbasin Water Transfer Tunnel (9)	\$ 46,765,000	\$ 22,402,395	\$ 22,402,395	\$ 22,402,395	\$ 22,402,395	N/A	N/A	N/A	N/A	N/A	N/A
Canal (10)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	\$ 900,000	\$ 900,000	\$ 900,000	\$ 900,000
Minimum Release Facility (11)	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000	\$ 837,000
Operation Facilities (12)	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000	\$ 1,139,000
Subtotal Direct Cost	\$ 172,106,000	\$ 327,550,132	\$ 261,182,132	\$ 185,054,132	\$ 130,398,132	\$ 47,458,902	\$ 78,733,904	\$ 331,752,933	\$ 185,352,933	\$ 136,552,933	\$ 35,048,933
Contingency (13)	\$ 28,868,000	\$ 98,265,040	\$ 78,354,640	\$ 55,516,240	\$ 39,119,440	\$ 14,237,670	\$ 23,520,171	\$ 99,525,880	\$ 55,805,880	\$ 40,965,880	\$ 10,514,980
Direct Cost	\$ 200,974,000	\$ 425,815,171	\$ 339,536,771	\$ 240,570,371	\$ 169,517,572	\$ 61,696,572	\$ 102,354,075	\$ 431,278,813	\$ 240,958,813	\$ 177,518,813	\$ 45,563,613
Engineering and Administration (14)	\$ 30,056,000	\$ 51,097,821	\$ 40,744,413	\$ 28,868,445	\$ 20,342,109	\$ 9,254,486	\$ 12,282,489	\$ 51,753,458	\$ 28,915,058	\$ 21,302,258	\$ 5,467,634
Construction Cost (2004 price level)	\$ 231,030,000	\$ 476,912,992	\$ 380,281,184	\$ 269,438,816	\$ 189,859,580	\$ 70,951,058	\$ 114,636,564	\$ 483,032,271	\$ 269,873,871	\$ 198,821,071	\$ 51,031,247
Rounded Construction Costs (2004 price level)	\$ 230,430,000	\$ 476,910,000	\$ 380,280,000	\$ 269,440,000	\$ 189,860,000	\$ 70,950,000	\$ 114,640,000	\$ 483,030,000	\$ 269,870,000	\$ 198,820,000	\$ 51,030,000
New Dam Cost Comparison						\$ 189,860,000		\$ 114,640,000			\$ 198,820,000

1. Land acquisition costs include reservoir area plus 20% for borrow areas, construction roads, structures, disposal areas, construction camp and other temporary structures using and average estimated cost of \$1000/ha from the ACP.

2. Resettlement costs are not estimated. Assume few families to be relocated in these area. Settlement costs listed as 20.6 million in Rio Indio Report.

3. Assume general costs are equal to the ratio of the land acquisition and general costs of Rio Indio.

4. Estimated cost for the diversion is based on tunnel area using the peak PMF because information is not available for the 50-year flood. Minimum tunnel diameter assumed to be 2.5m diameter finished.

5. Estimated cost for the main dam derived from Rio Indio estimated costs based on the volume of the rockfill shell. Price per cubic meters = \$19.52.

6. Estimated costs for the spillway calculated using ratios of the peak PMF compared to the cost of Rio Indio. A factor of 1.2 was applied here to account for unknowns.

7. Estimated cost of the low-level outlet works is equal to the cost for Rio Indio to convert the diversion tunnel to a low-level outlet works. Assume that the outlet works will be similar in all cases.

8. Estimated cost for the saddle dam derived from Rio Indio costs based on the volume of fill. Fill volume was approximated using cross section from Exhibit 4-4 (~840,000 m^3).

It is assumed that the cost of the saddle dam includes both saddle dams for Rio Indio, so the cost is divided by 2. Price per cubic meter of saddle dam = \$4.42.

Refer to Saddle Dam spreadsheets for clarification.

9. Estimated cost for the tunnel (from Teria 1 to Gatun Lake) is based on Rio Indio cost estimate using ratios of tunnel lengths. Assume similar tunnels. Excavation unknown.

10. Canal estimate performed by URS Tampa.

11. Estimated cost for the minimum release facility is equal to the estimated cost of the Rio Indio, assuming minimum realease is at the same depth below the dam crest. This is the high level outlet works similar to the Rio Indio design.

12. Estimated cost for the operation facilities is equal to the estimated cost of the Rio Indio.

13. Contingency of 30%. Contingency is higher than that used for Rio Indio due to the large amount of unknowns in this estimate.

14. Engineering and administration fees of 15%.

15. Gross storage values were not provided. Numbers are rough estimate based on the information provided, including dam profiles and reservoir areas.

COMBINATIONS

	Total Cost (\$)	Main Dam Cost (\$)	Elevation (m)	Storage (MCM)
Rio Indio	230,430,000	52,704,000	85	1294
Teria 1 (115m)	189,860,000	87,840,000	115	175
Teria 1 (130m)	269,440,000	142,496,000	130	290
Teria 1 (145m)	380,280,000	218,624,000	145	450
Teria 1 (155m)	476,910,000	284,992,000	155	570
Teria 2 (260m)	70,950,000	33,184,000	260	245
Teria 2 (285m)	114,640,000	64,416,000	285	430
Indio 2B (300m)	51,030,000	19,520,000	300	20
Indio 2B (360m)	198,820,000	121,024,000	360	160
Indio 2B (375m)	269,870,000	169,824,000	375	223
Indio 2B (400m)	483,030,000	316,224,000	400	370
Rio Indio	230,430,000	52,704,000		1294
Teria 1(155) + Teria 2(260)	547,860,000	318,176,000		815
Teria 1(155) + Teria 2(285)	591,550,000	349,408,000		1,000
Teria 1(145) + Teria 2(260)	451,230,000	251,808,000		695
Teria 1(145) + Teria 2(285)	494,920,000	283,040,000		880
Teria 1(130) + Teria 2(260)	340,390,000	175,680,000		535
Teria 1(130) + Teria 2(285)	384,080,000	206,912,000		720
Teria 1(115) + Teria 2(260)	260,810,000	121,024,000		420
Teria 1(115) + Teria 2(285)	304,500,000	152,256,000		605
Teria 1(155) + Indio 2B(400)	959,940,000	601,216,000		940
Teria 1(155) + indio 2B(375)	746,780,000	454,816,000		793
Teria 1(155) + Indio 2B(360)	675,730,000	406,016,000		730
Teria 1(145) + Indio 2B(400)	863,310,000	534,848,000		820
Teria 1(145) + Indio 2B(375)	650,150,000	388,448,000		673
Teria 1(145) + Indio 2B(360)	579,100,000	339,648,000		610
Teria 1(130) + Indio 2B(400)	752,470,000	458,720,000		660
Teria 1(130) + Indio 2B(375)	539,310,000	312,320,000		513
Teria 1(130) + Indio 2B(360)	468,260,000	263,520,000		450
Teria 1(115) + Indio 2B(400)	672,890,000	404,064,000		545
Teria 1(115) + Indio 2B(375)	459,730,000	257,664,000		398
Teria 1(115) + Indio 2B(360)	388,680,000	208,864,000		335

Numbers are based on **total** storage volume provided by Storage Capacity Curves.

There was no total storage volume provided for Teria 2 at elevation 285m. This was estimated using the Storage Capacity Curves provided. Full storage capacity assumed to be reached when water level at the top of the parapet wall.

ANNEX 2-D

ANNEX 4-A

**Panama Canal
Hydrologic Modeling
of
ROCC Water Options
Letter Report**

By

URS

March 30, 2004

Introduction

This appendix is provided to summarize the results presented in the comparative evaluation of hydrologic options for potential expansion of water supply to the Panama Canal. These results, specifically, are based on hydrologic simulation of each of the twelve water options analyzed in this project. The simulations are used to determine the amount of water supplied to the canal, expressed in units of volume per time, e.g., lockages/day, MCM/yr.

Hydrologic Simulation Procedure

The twelve water options were modeled using the HEC-5 simulation program, developed by the US Army Corps of Engineers. A base model was provided by the ACP. This base model contained the following information about the hydrologic characteristics of the water supply system, which were used to model the twelve water options proposed in this project.

- (a) Reservoir characteristics (volume, area, elevation, discharge) for Lake Gatún, Lake Madden, and the reservoir at Río Indio.
- (b) Inflow time series into Lake Gatún, Lake Madden, and the reservoir at Río Indio.
- (c) Flow diversions from the outlets at Lake Gatún, Lake Madden, and the reservoir at Río Indio.
- (d) Evaporation rates for Lake Gatún, Lake Madden, and the reservoir at Río Indio.
- (e) Operating rules for releases from Lake Gatún, Lake Madden, and the reservoir at Río Indio.
- (f) Water demands on the system from the Panama Canal.

This base model was modified to simulate the twelve water options proposed for the ROCC supply to the Panama Canal:

- 1. Indio 80-40**
- 2. Indio 45-40**
- 3. Alto Indio 50-40**
- 4. Alto Indio 45-40**
- 5. Caño Sucio 100-90 and Indio 80-40**
- 6. Caño Sucio 100-90 and Indio 45-40**
- 7. Toabré 95-50 and Indio 80-40**
- 8. Toabré 95-50 and Indio 45-40**
- 9. Toabré 100-90, Caño Sucio 100-90 and Indio 80-40**
- 10. Toabré 100-90, Caño Sucio 100-90 and Indio 45-40**
- 11. Teria River**
- 12. Teria and Cabecera Indio**

These modifications were done to incorporate the information presented in items (a)-(f) above for each of the water options 1-12. In the case of option 1 (Indio 80-40), the simulation was done to verify the results provided by previous reports [USACE, 1999: *Panama Canal Reconnaissance Study: Identification, Definition and Evaluation of Water Supply Projects, Volume 1*, prepared by the US Army Corps of Engineers, December 1999].

A summary of the hydrologic parameters used for each water option is presented in **Table 1**.

Table 1-A, HEC5 Input Data for Gatun (ID#40)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Monthly Diversion Pedro Miguel Locks (cfs)	*Monthly Diversion Gatun Locks (cfs)	*Water Supply M&I (cfs)
0	0	0	40	4.24	81.5	87.0	87.8	1,578	1,625	123
833,700	0	56,544	50	4.59	81.5	86.3	87.8	1,603	1,596	126
1,781,700	0	70,404	60	5.37	81.5	85.4	87.8	1,624	1,586	123
2,729,700	1,890	84,264	70	5.25	81.5	84.7	87.8	1,563	1,543	127
3,393,300	42,790	93,966	77	3.30	81.5	84.7	86.5	1,497	1,474	117
3,488,100	58,878	95,353	78	2.90	81.5	84.7	86.5	1,421	1,395	127
3,584,200	69,463	96,740	79	3.04	81.5	84.7	86.5	1,416	1,404	121
3,681,600	80,672	98,127	80	3.13	81.5	84.7	86.5	1,435	1,424	124
3,780,300	92,479	99,414	81	2.88	81.5	85.0	86.5	1,389	1,395	115
3,880,300	104,860	100,702	82	2.87	81.5	85.9	86.8	1,439	1,529	124
3,981,600	117,796	101,990	83	2.67	81.5	87.3	87.4	1,394	1,448	123
4,084,200	131,268	103,277	84	3.35	81.5	87.5	87.8	1,486	1,476	119
4,188,100	145,260	104,566	85							
4,293,300	159,756	105,853	86							
4,399,800	174,743	107,141	87							
4,507,600	190,208	108,382	88							
4,616,700	206,139	109,670	89							
4,727,200	222,525	110,957	90							
5,279,700	300,000	117,392	95							
5,832,300	350,000	123,827	100							
6,384,700	400,000	130,262	105							

* Note: Data is 5 year average from 1993 to 1997 as computed by Army Corps.

Table 1-B, HEC5 Input Data for Madden (ID#50)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Water Supply M&I (cfs)		
0	1,000	0	140	4.944	190.00	249.00	252.00	185		
16,000	10,000	1,600	160	5.14	190.00	243.00	252.00	188.00		
54,400	15,000	3,840	180	5.85	190.00	233.00	252.00	190.00		
127,250	20,000	4,608	190	5.03	190.00	221.00	245.00	190.00		
136,890	22,000	4,800	192	3.37	190.00	217.00	245.00	191.00		
146,510	23,000	4,992	194	2.88	190.00	215.00	245.00	188.00		
156,700	24,000	5,184	196	3.24	190.00	217.00	245.00	188.00		
167,290	25,000	5,376	198	3.21	190.00	222.00	245.00	187.00		
178,350	26,000	5,568	200	2.89	190.00	228.00	245.00	187.00		
184,080	26,150	5,792	201	3.00	190.00	236.00	248.00	180.00		
189,992	26,300	6,016	202	2.58	190.00	247.00	251.00	182.00		
195,914	26,400	6,144	203	3.67	190.00	252.00	252.00	183.00		
202,066	26,500	6,272	204							
208,356	26,750	6,400	205							
214,761	27,000	6,528	206							
221,281	27,150	6,624	207							

Table 1-B Continued, HEC5 Input Data for Madden (ID#50)
(data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	*Water Supply M&I (cfs)		
227,916	27,300	6,720	208							
234,665	27,400	6,784	209							
241,529	27,500	6,848	210							
248,520	27,650	6,976	211							
255,579	27,800	7,104	212							
262,764	27,900	7,168	213							
270,041	28,000	7,296	214							
277,433	28,150	7,488	215							
284,963	28,300	7,616	216							
292,654	28,400	7,744	217							
300,505	28,500	7,936	218							
308,517	28,650	8,064	219							
316,667	28,800	8,198	220							
333,370	29,000	8,480	222							
350,573	29,300	8,762	224							
368,297	29,500	9,043	226							
386,639	29,800	9,318	228							
405,556	30,000	9,587	230							
425,000	30,100	9,856	232							
444,904	34,100	10,125	234							
465,289	41,100	10,394	236							
486,226	50,400	10,630	238							
507,782	60,700	10,912	240							
529,880	74,000	11,168	242							
552,525	88,000	11,424	244							
575,781	103,700	11,680	246							
599,472	120,800	11,936	248							
623,577	139,300	12,179	250							
648,140	159,200	12,422	252							
673,255	180,600	12,666	254							
698,852	203,500	12,909	256							
724,908	227,700	13,146	258							
751,400	253,600	13,376	260							
778,340	281,001	13,606	262							
805,624	310,000	13,837	264							
832,668	340,700	14,080	266							
859,711	373,100	14,304	268							
886,754	407,100	14,528	270							

Table 1-C, HEC5 Input Data for Indio (ID# 200)

(Indio 80 data from Original ACOE HEC-5 run)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Indio 80			Indio 45		
					Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
33,544	0	1,573	66	4.41	131.2	262.00	262.47	131.2	148	148
229,649	2,021	4,371	131	4.62	131.2	257.57	262.47	131.2	147	148
318,191	2,355	5,401	148	5.23	131.2	252.45	262.47	131.2	146	148
406,733	2,646	6,425	164	4.86	131.2	247.43	262.47	131.2	146	148
528,932	2,909	7,026	180	3.59	131.2	242.41	262.47	131.2	145	148
651,131	3,150	7,624	197	3.13	131.2	237.39	262.47	131.2	145	148
708,070	3,241	8,014	203	3.29	131.2	237.39	262.47	131.2	145	148
765,009	3,330	8,404	210	3.15	131.2	242.41	262.47	131.2	145	148
821,947	3,416	8,794	217	3.08	131.2	247.43	262.47	131.2	146	148
878,890	3,501	9,185	223	3.13	131.2	252.45	262.47	131.2	146	148
935,825	3,583	9,575	230	2.83	131.2	257.57	262.47	131.2	147	148
1,004,440	3,663	9,915	236	3.31	131.2	262.00	262.47	131.2	148	148
1,073,040	3,742	10,255	243							
1,141,660	3,820	10,595	249							
1,210,270	3,895	10,935	256							
1,278,880	3,969	11,275	262							
1,384,200	4,060	11,671	271							
1,489,530	4,149	12,059	279							
1,700,190	4,321	12,842	295							

Table 1-D, HEC5 Input Data for ALTO INDIO (ID# 200)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Alto Indio 50			Alto Indio 45		
					Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
0	809	510	70	4.41	131	164	164	131	148	148
400	955	660	79	4.62	131	163	164	131	147	148
1,000	1,102	820	87	5.23	131	161	164	131	147	148
2,500	1,249	970	96	4.86	131	160	164	131	146	148
5,100	1,395	1,120	104	3.59	131	159	164	131	145	148
9,800	1,542	1,260	113	3.13	131	158	164	131	145	148
16,100	1,688	1,410	122	3.29	131	158	164	131	145	148
23,900	1,835	1,590	130	3.15	131	159	164	131	145	148
33,400	1,982	1,750	139	3.08	131	160	164	131	146	148
44,400	2,128	1,870	148	3.13	131	161	164	131	147	148
57,200	2,275	2,010	156	2.83	131	163	164	131	147	148
72,200	2,422	2,160	165	3.31	131	164	164	131	148	148
89,000	2,568	2,290	173							
108,300	2,715	2,410	182							
130,300	2,861	2,540	191							
155,100	3,008	2,680	199							
182,100	3,155	2,810	208							
211,400	3,301	2,940	217							
242,800	3,448	3,080	225							
276,000	3,595	3,210	234							

Table 1-E, HEC5 Input Data for CANO SUCIO (ID# 300)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Cano Sucio 100/90				
					Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)		
0	3,600	0	279	4.41	295	328	328		
1,700	3,700	310	287	4.62	295	327	328		
3,400	3,800	620	295	5.23	295	325	328		
13,100	3,900	1,110	303	4.86	295	324	328		
22,700	4,000	1,610	312	3.59	295	323	328		
40,900	4,100	2,340	320	3.13	295	322	328		
59,200	4,100	3,060	328	3.29	295	322	328		
95,700	4,300	4,520	344	3.15	295	323	328		
				3.08	295	324	328		
				3.13	295	325	328		
				2.83	295	327	328		
				3.31	295	328	328		

Table 1-F, HEC5 Input Data for TOABRE (ID# 400)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Toabre 95-50			Toabre 100-90		
					Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)
73,000	1,800	1,480	164	4.41	164	311	311.7	295	328	328
89,200	2,100	1,980	180	4.62	164	306	311.7	295	327	328
121,600	2,400	2,590	197	5.23	164	300	311.7	295	325	328
162,100	2,700	3,210	213	4.86	164	295	311.7	295	324	328
194,600	3,000	3,950	230	3.59	164	289	311.7	295	323	328
283,700	3,200	4,820	246	3.13	164	283	311.7	295	322	328
381,000	3,500	5,560	262	3.29	164	283	311.7	295	322	328
486,400	3,600	6,420	279	3.15	164	289	311.7	295	323	328
583,700	3,800	7,910	295	3.08	164	295	311.7	295	324	328
744,200	4,000	9,640	312	3.13	164	300	311.7	295	325	328
916,100	4,100	11,370	328	2.83	164	306	311.7	295	327	328
1,094,500	4,300	13,590	344	3.31	164	311	311.7	295	328	328
1,378,200	4,500	16,060	361							
1,662,000	4,700	18,780	377							
1,945,700	4,800	21,750	394							

Table 1-G, HEC5 Input Data for TERIA 1 (ID# 500)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
0	3,000	5	152	4.41	377	508	508.5			
1,692	3,200	119	188	4.62	377	504	508.5			
8,616	3,500	266	223	5.23	377	498	508.5			
21,574	3,600	484	259	4.86	377	493	508.5			
43,907	3,800	768	295	3.59	377	488	508.5			
76,484	4,000	1,071	330	3.13	377	483	508.5			

Table 1-G Continued, HEC5 Input Data for TERIA 1 (ID# 500)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
121,547	4,100	1,458	366	3.29	377	483	508.5			
181,037	4,300	1,897	402	3.15	377	488	508.5			
257,067	4,500	2,381	437	3.08	377	493	508.5			
350,664	4,700	2,875	473	3.13	377	498	508.5			
462,258	4,800	3,388	509	2.83	377	504	508.5			
				3.31	377	508	508.5			

Table 1-H, HEC5 Input Data for Teria 2 (ID# 600)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
0	3,000	0	548	4.41	740	870	870			
12	3,200	2	580	4.62	740	865	870			
406	3,500	31	612	5.23	740	860	870			
2,933	3,600	126	644	4.86	740	855	870			
8,847	3,800	252	677	3.59	740	850	870			
19,433	4,000	416	709	3.13	740	845	870			
36,345	4,100	643	741	3.29	740	845	870			
61,457	4,300	912	773	3.15	740	850	870			
95,390	4,500	1,210	806	3.08	740	855	870			
140,880	4,700	1,624	838	3.13	740	860	870			
200,391	4,800	2,075	870	2.83	740	865	870			
				3.31	740	870	870			

Table 1-I, HEC5 Input Data for Indio 2 (ID#700)

Reservoir Storage (acre-ft)	Max Reservoir Outlet Flow (cfs)	Reservoir Pool Area (acre)	Reservoir Pool Elevation (ft)	*5year Ave Evap Rate (in)	Rule Level (Inactive) (ft)	Rule Level (Conserve) (ft)	Rule Level (Flood) (ft)			
0	3,000	5	842	4.41	1,180	1,312	1,312			
1,514	3,200	64	889	4.62	1,180	1,307	1,312			
6,342	3,500	144	936	5.23	1,180	1,302	1,312			
15,021	3,600	226	983	4.86	1,180	1,297	1,312			
28,055	3,800	347	1,030	3.59	1,180	1,292	1,312			
48,133	4,000	520	1,077	3.13	1,180	1,287	1,312			
77,573	4,100	724	1,124	3.29	1,180	1,287	1,312			
116,127	4,300	932	1,171	3.15	1,180	1,292	1,312			
165,887	4,500	1,200	1,218	3.08	1,180	1,297	1,312			
228,992	4,700	1,484	1,265	3.13	1,180	1,302	1,312			
305,699	4,800	1,784	1,312	2.83	1,180	1,307	1,312			
				3.31	1,180	1,312	1,312			

Constant Diversion Flow Rates per Option		
	Cubic Meters per Second	Cubic Feet per Second
Indio	2.6	91.8
Cano Sucio	0.75	26.5
Toabre	4.1	144.8
Teria1	0.74	26.1
Teria2	0.34	12.0
Indio2	0.64	22.6

Hydrologic Reliability Calculation

Hydrologic reliability of the Panama Canal system is defined as the ability to provide sufficient water for unrestricted operation. Unrestricted operation for the Panama Canal would be its ability to pass all requested navigation without draft restrictions and to meet all M&I water supply needs during the designated period. The hydrologic reliability is represented by a ratio of the volume of water provided to the volume of water demanded for canal operations during the designated period with no draft restrictions.

$$\text{Hydrologic Reliability} = \left[\frac{\sum \text{Vol_Provided}}{\sum \text{Vol_Demanded}} \right] \times 100\%$$

In the past, when water shortages have been experienced, the Panama Canal has continued to provide passage to all requesting vessels. This generally resulted in the lake elevation becoming so low that draft restrictions had to be imposed on large vessels. Draft restrictions obviously reduce the capacity of the vessels, and thus, results in a significant economic impact on world shipping. As future demands for both navigation and M&I water increase, the frequency of shortages is also expected to increase.

Current conditions in the Panama Canal permit vessels to load to a maximum draft of 39.5-ft (12.0-m) when Gatun Lake is equal or above elevation 81.5-ft (24.8-m) MSL. This operation allows the system to meet all demands but allows Lake Gatún to drop to levels below elevation 81.5-ft (24.8-m) MSL. Each time Gatun Lake drops below elevation 81.5-ft (24.8-m) MSL indicates a period that draft restrictions are required. This serves as a good indicator of the systems current reliability [USACE, 1999]. As demand for additional water increases, the ability of the Panama Canal to reliably transit vessels through the system will decrease. The current high reliability that the Panama Canal enjoys can only be maintained if water saving methods are developed or facilities are constructed that provide additional water supply and storage.

The level of hydrologic reliability for the 1948-1999 period is approximately 99.6 percent. We have used this hydrologic reliability as a target to determine the amount of water provided by each of the twelve supply options. The hydrologic reliability procedure then involves the calculation of the amount of water that each individual option can provide, subjected to 99.6 percent hydrologic reliability. This reliability is measured as the percentage of time during the 1948-1999 period during which the water level at Lake Gatún is at or above 81.5-ft (24.8-m) MSL. This is done by varying, for each option, the demand of water from the system until the target hydrologic reliability is met.

A summary of the hydrologic reliability calculations is presented in **Table 2**. For the purposes of relative comparison between the performance of the different water options, **Figures 1-12** show the simulated elevations of Lake Gatún for each option at a given demand level (chosen for these plots as 56.7 locks/day). All electronic files pertaining to the hydrologic reliability calculation are provided attached to this report.

Table 2:

Quantity of water provided by each hydrologic option at 99.6 percent hydrologic reliability

Option	Description	Locks/day	MCM/yr
1	Indio 80-40	15.5	1177
2	Indio 45-40	1.4	106
3	Alto Indio 50-40	0.7	53
4	Alto Indio 45-40	0.3	23
5	Caño Sucio 100-90 + Indio 80-40	18	1367
6	Caño Sucio 100-90 + Indio 45-40	3.9	296
7	Toabre 95-50 + Indio 80-40	31.2	2369
8	Toabre 95-50 + Indio 45-40	17.1	1298
9	Toabre 100-90 + Caño Sucio 100-90 + Indio 80-40	26.2	1989
10	Toabre 100-90 + Caño Sucio 100-90 + Indio 45-40	12.1	919
11	Teria Basin	5.1	387
12	Teria Basin + Cabecera Indio	5.3	402

Figure 1
Option 1: Indio 80-40
Total Demand = 56.7 locks/day

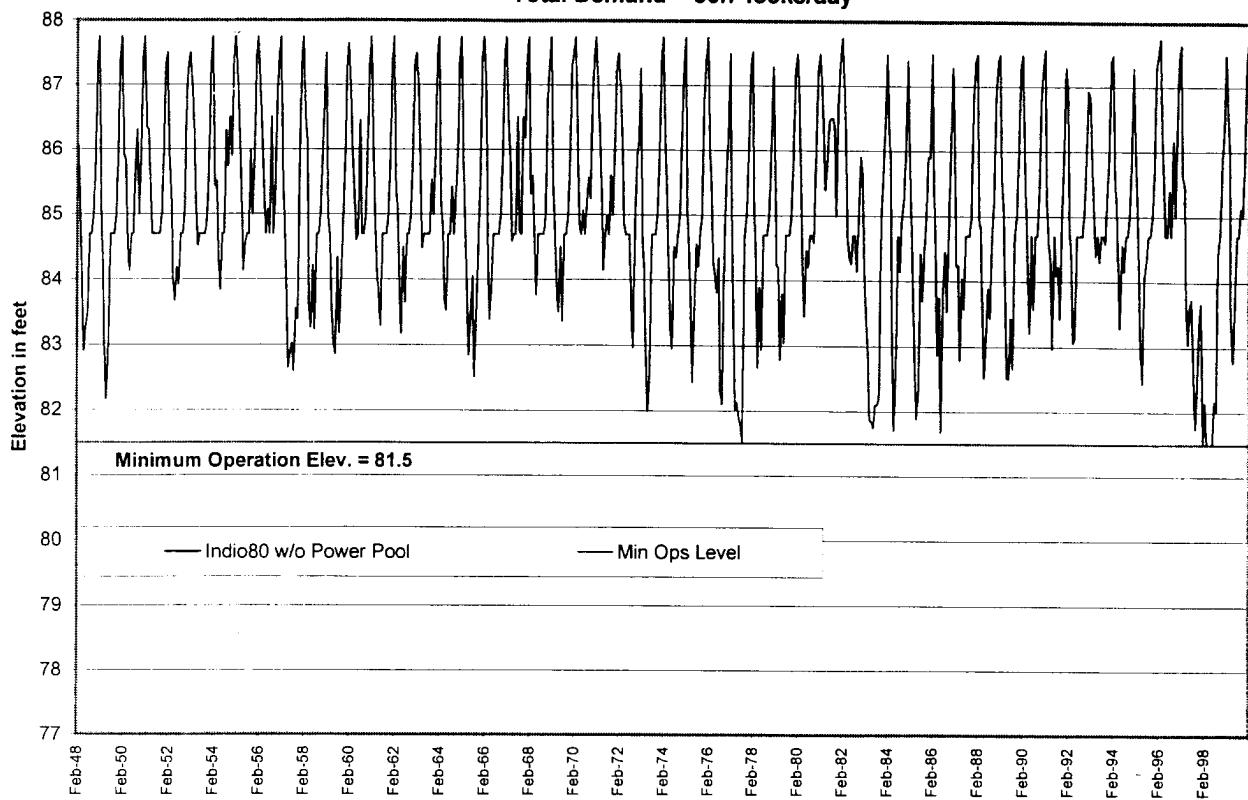


Figure 2
Option 2: Indio 45-40
Total Demand = 56.7 locks/day

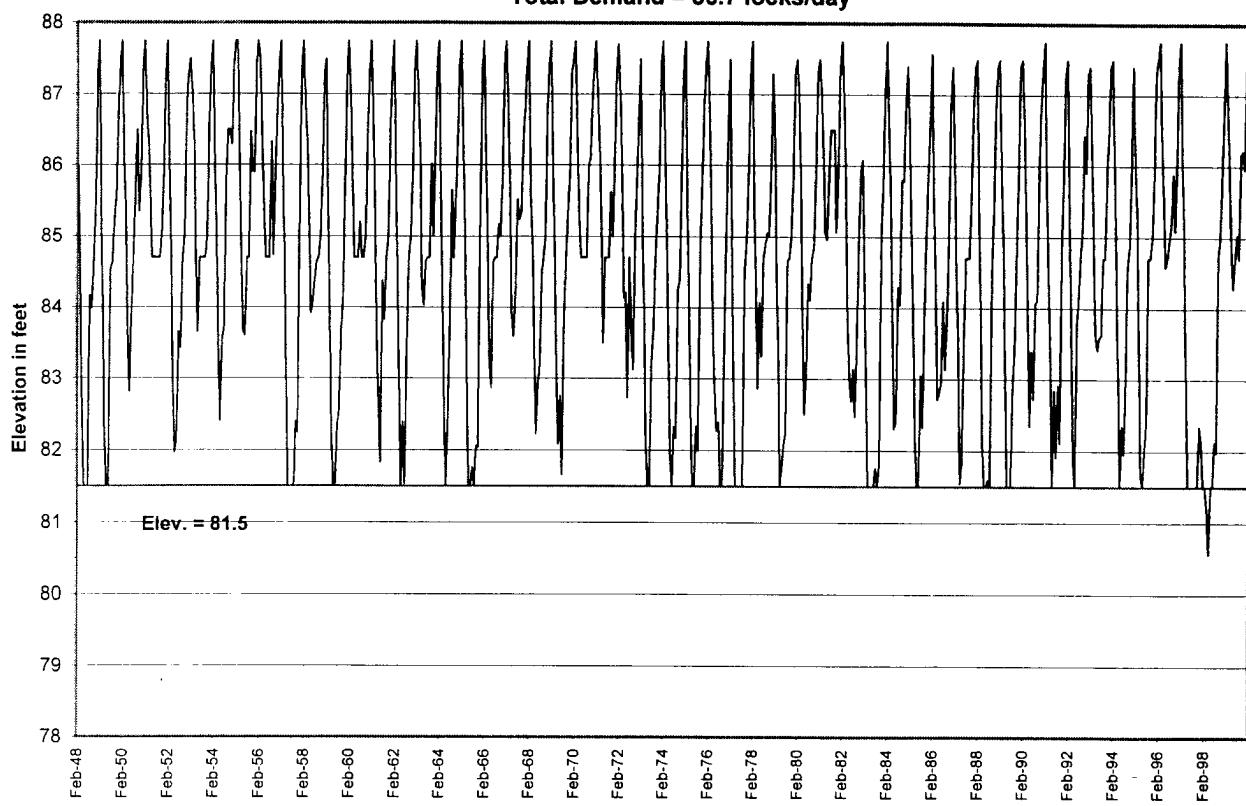


Figure 3
Option 3: Alto Indio 50-40
Total Demand = 56.7 locks/day

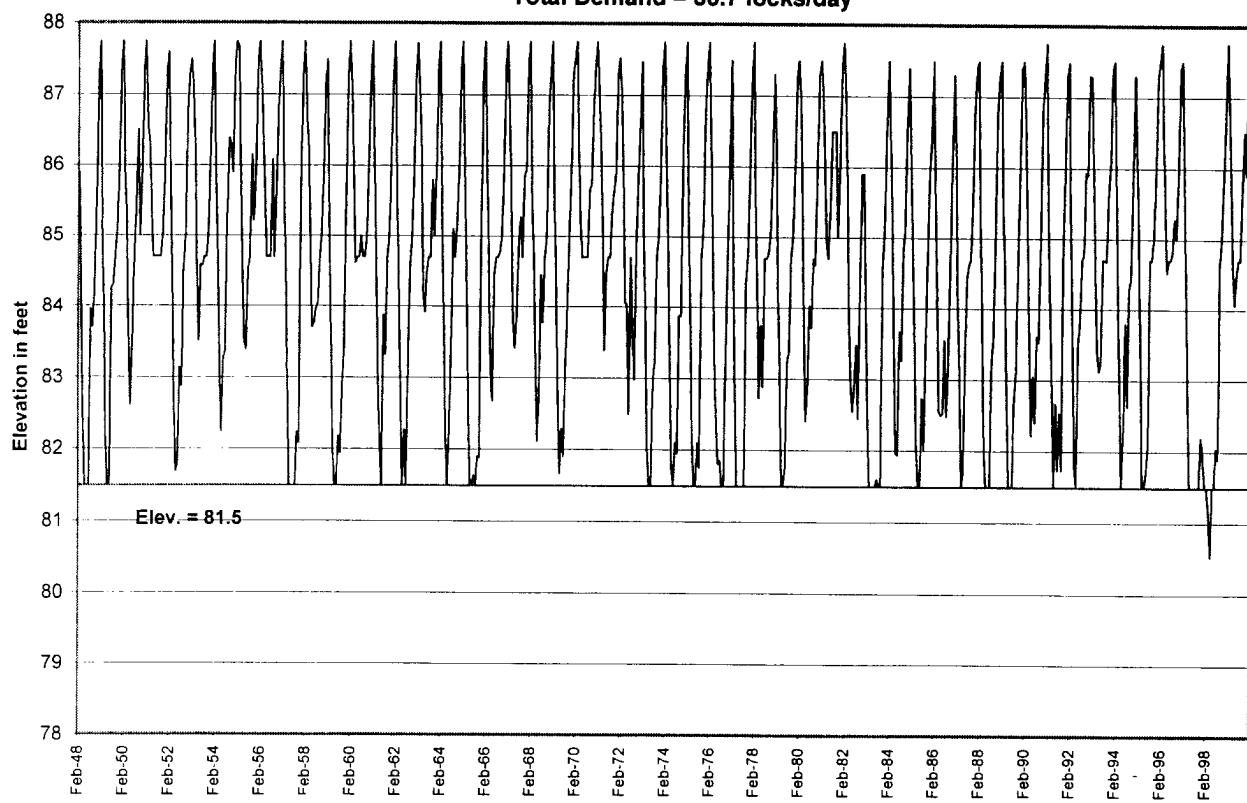


Figure 4
Option 4: Alto Indio 45-40
Total Demand = 56.7 locks/day

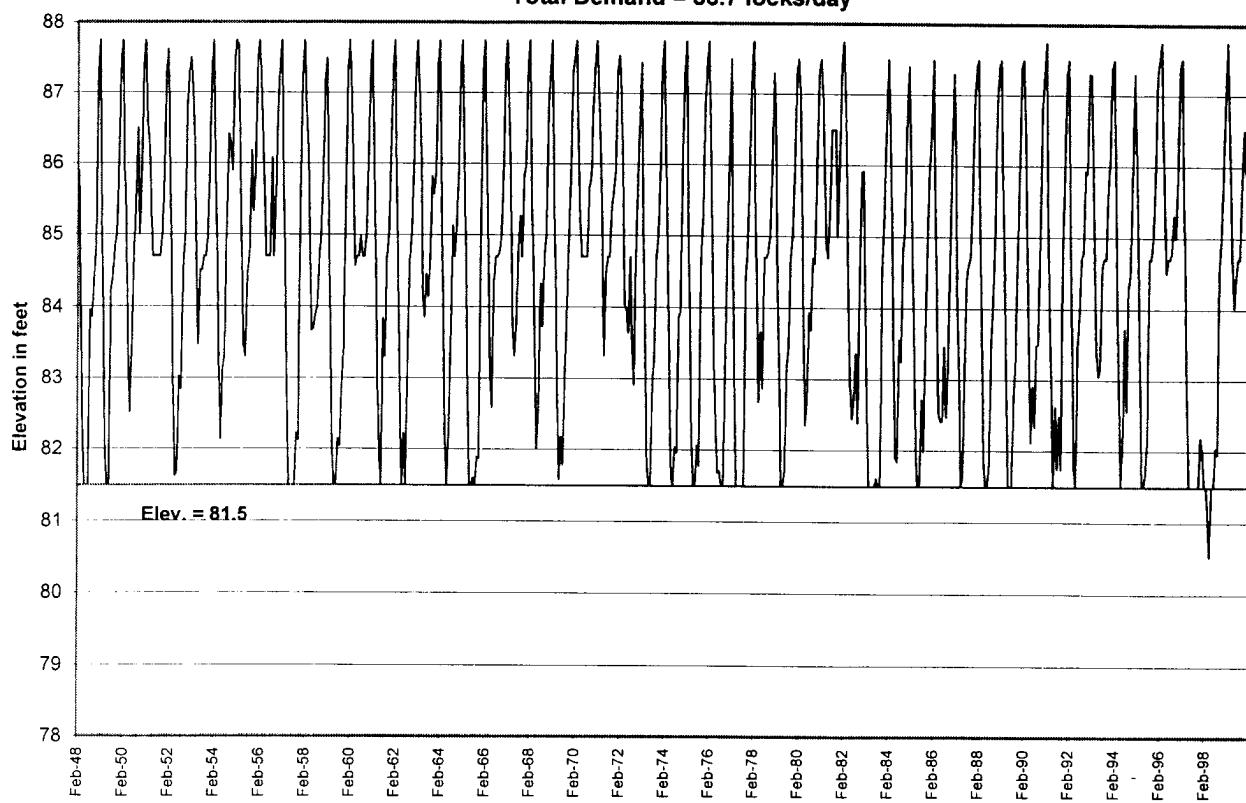


Figure 5
Option 5: Caño Sucio 100-90 + Indio 80-40
Total Demand = 56.7 locks/day

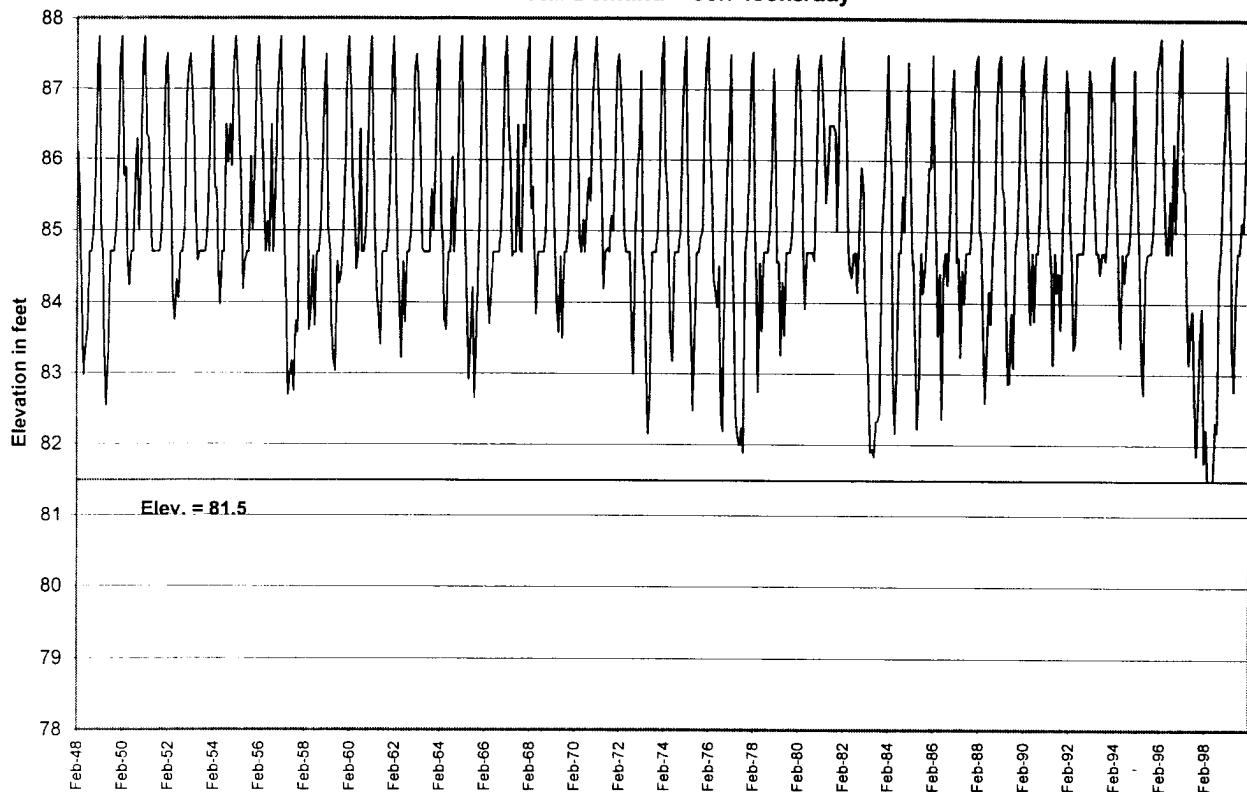


Figure 6
Option 6: Caño Sucio 100-90 + Indio 45-40
Total Demand = 56.7 locks/day

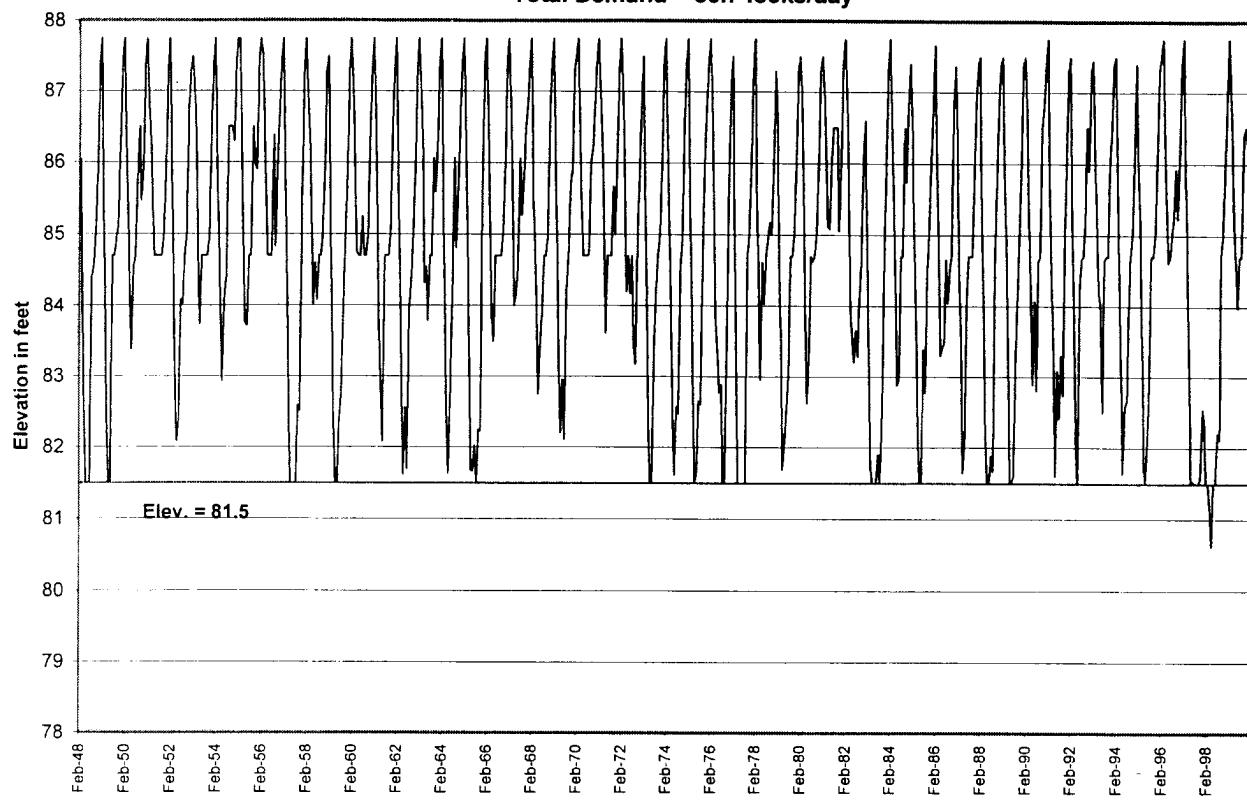


Figure 7
Option 7: Toabre 95-50 + Indio 80-40
Total Demand = 56.7 locks/day

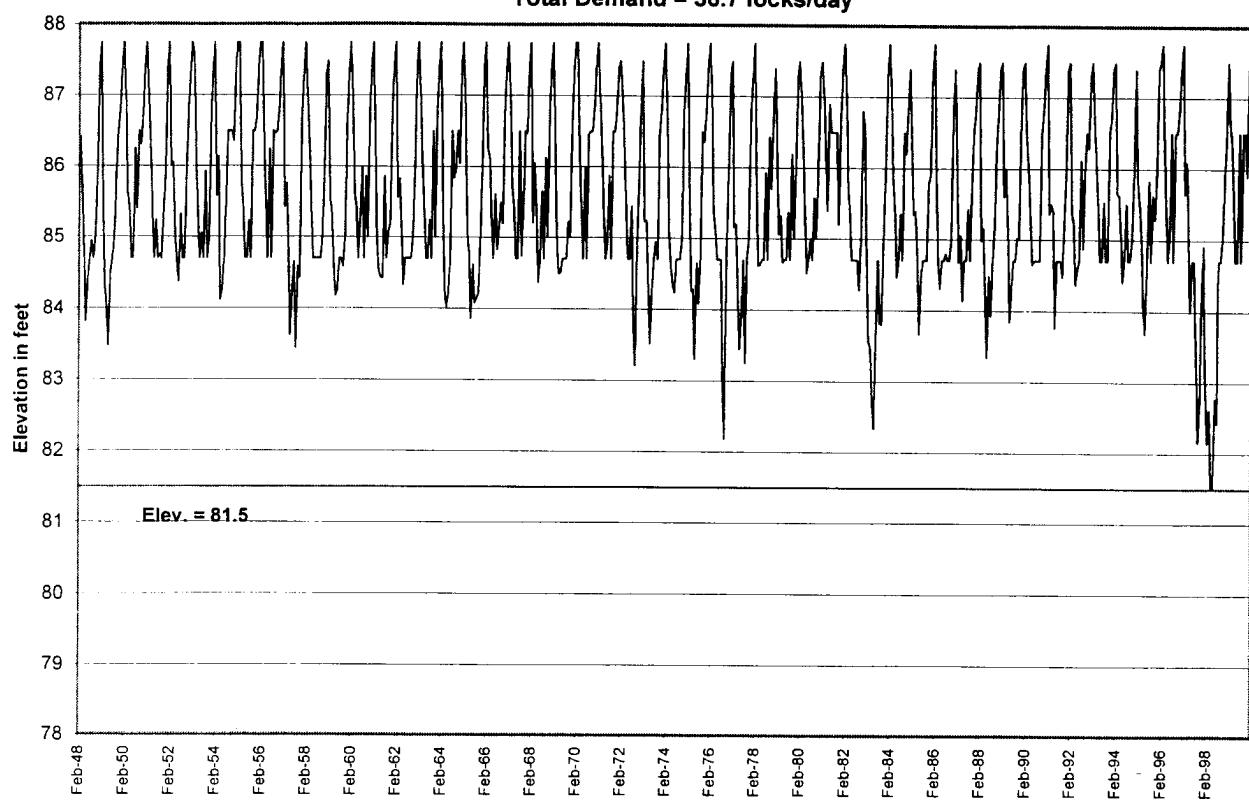


Figure 8
Option 8: Toabre 95-50 + Indio 45-40
Total Demand = 56.7 locks/day

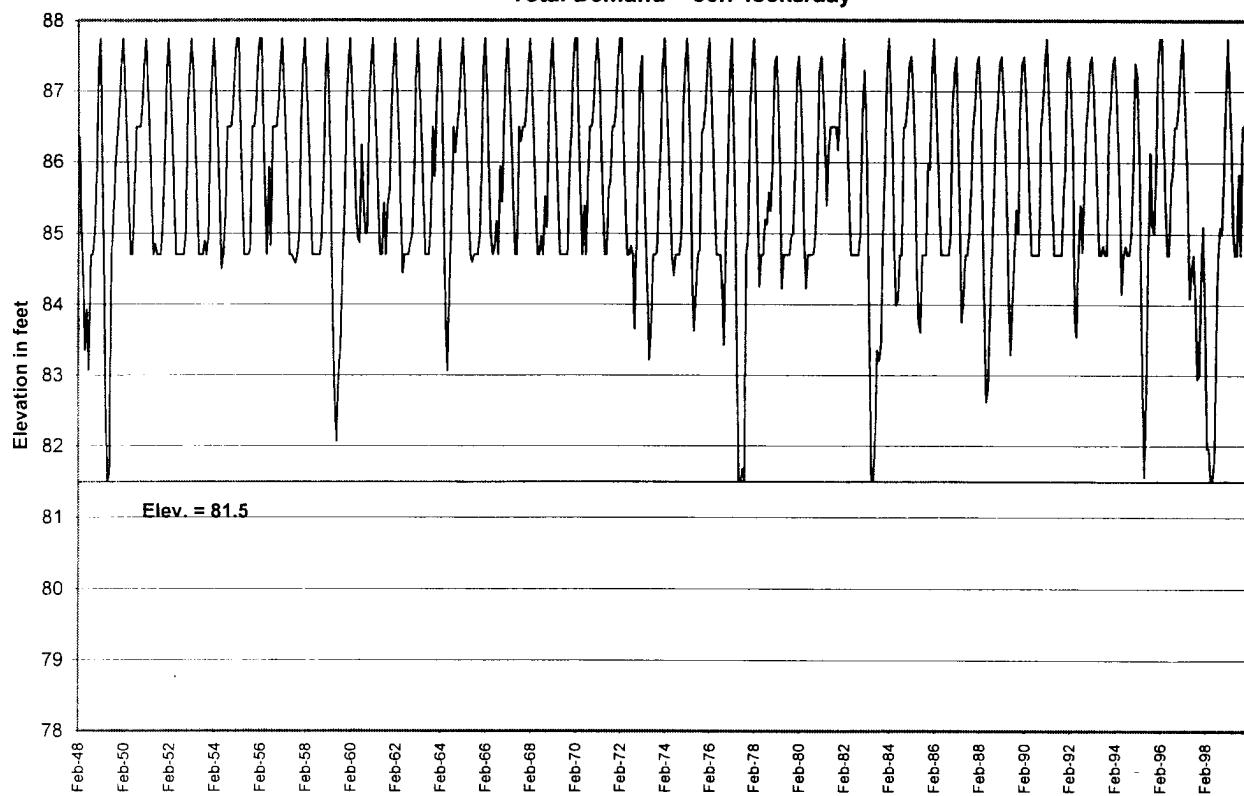


Figure 9
Option 9: Toabre 100-90 + Caño Sucio 100-90 + Indio 80-40
Total Demand = 56.7 locks/day

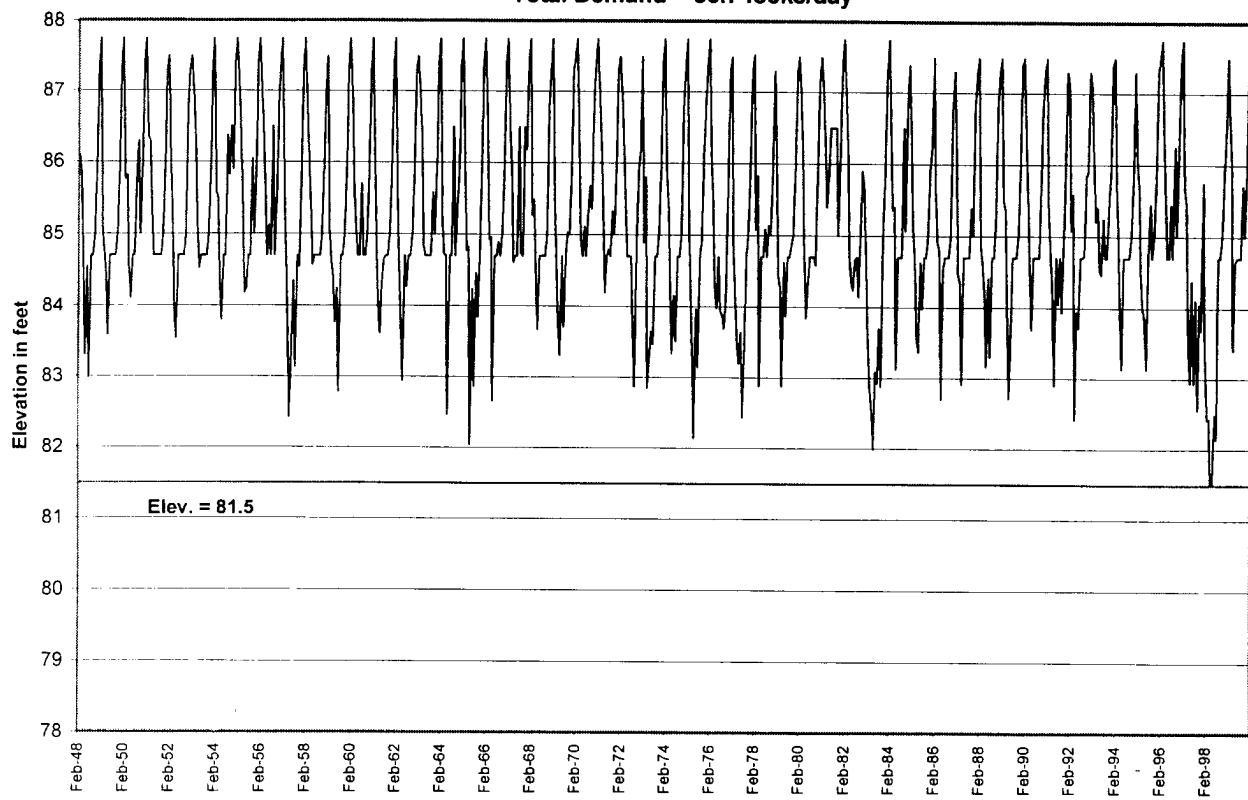


Figure 10
Option 10: Toabre 100-90 + Caño Sucio 100-90 + Indio 45-40
Total Demand = 56.7 locks/day

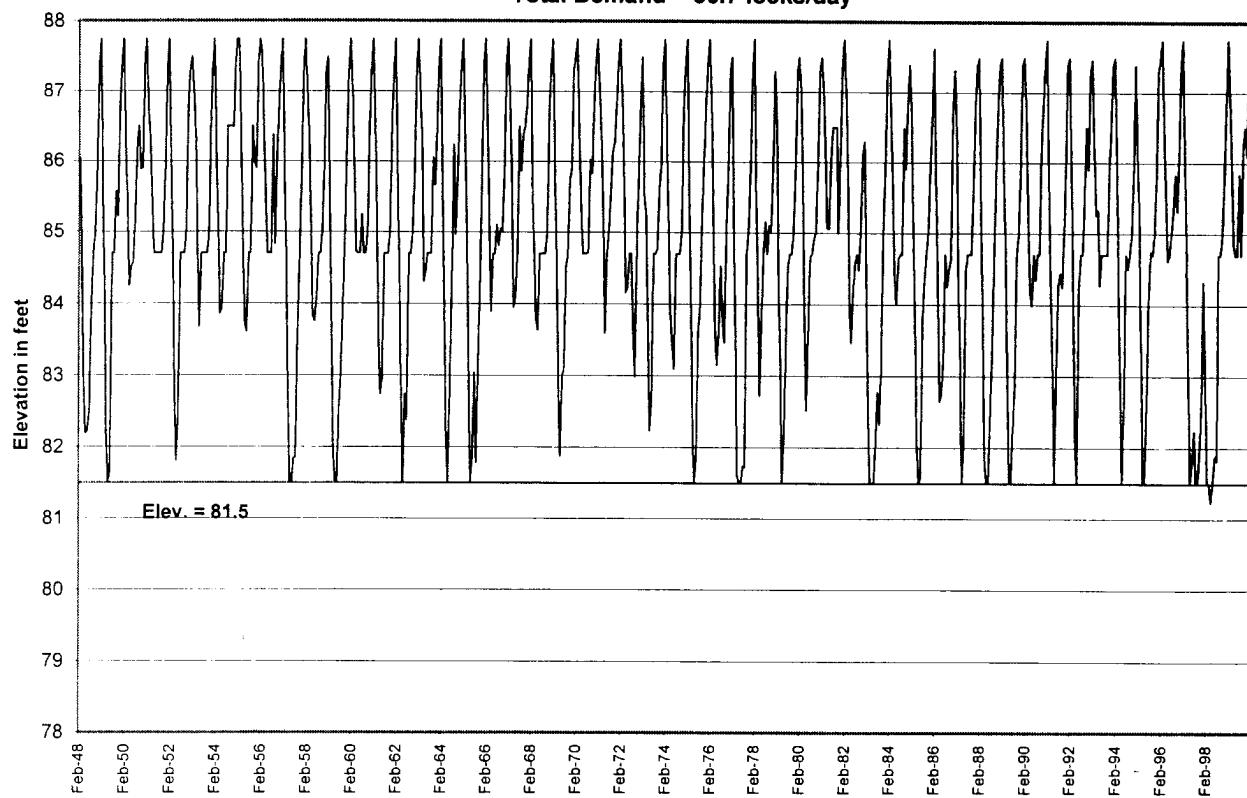


Figure 11
Option 11: Teria
Total Demand = 56.7 locks/day

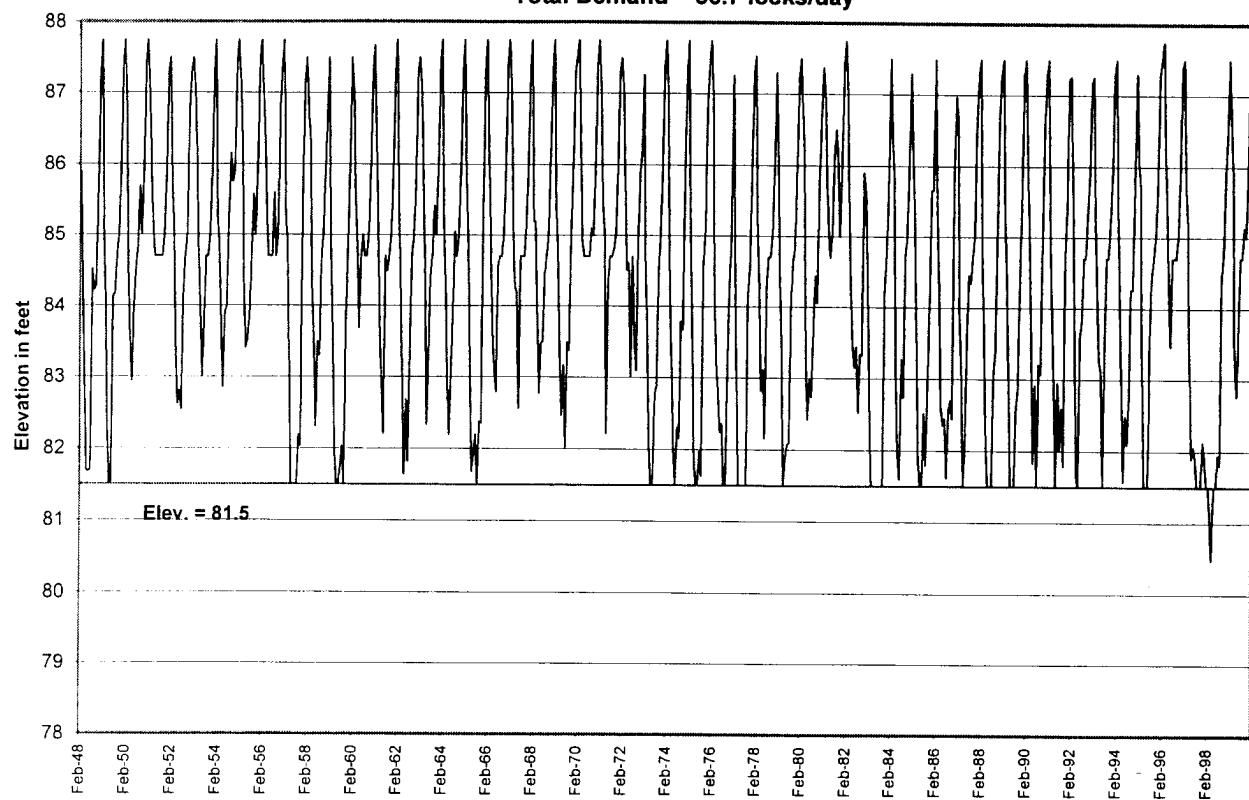
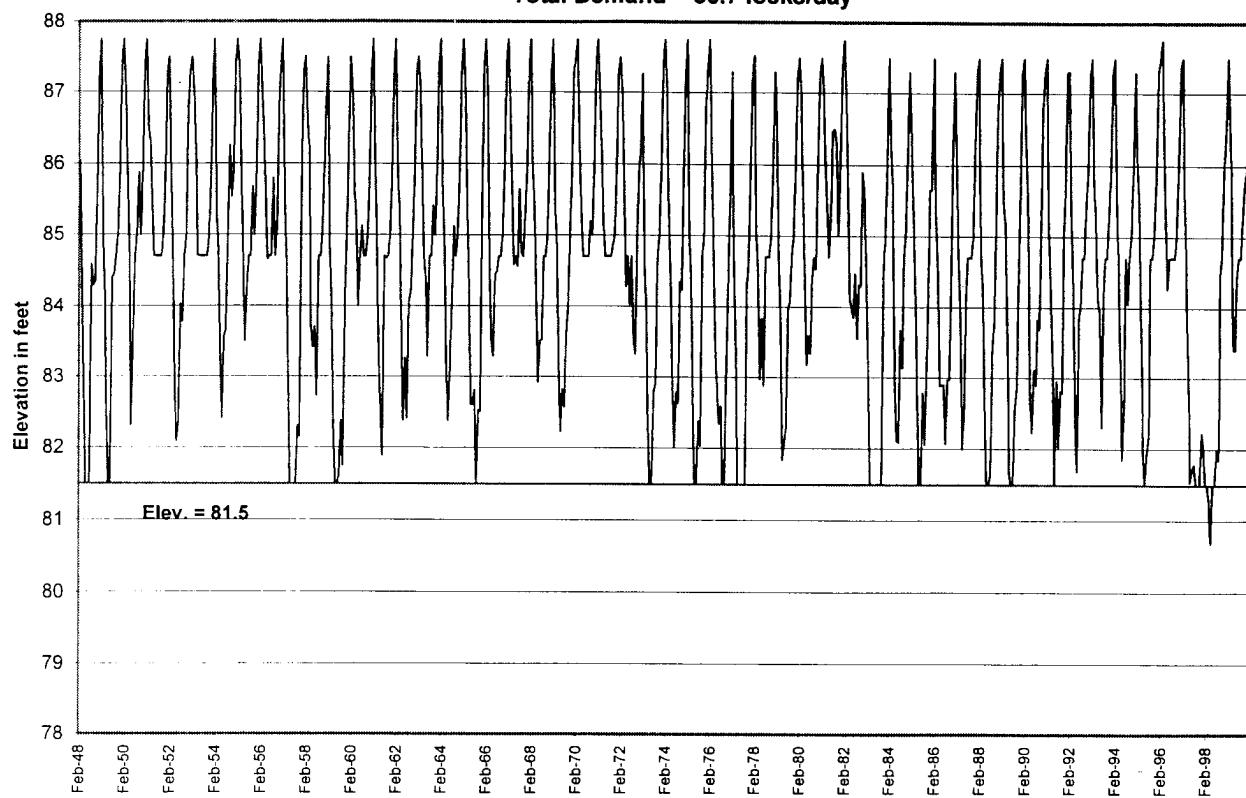


Figure 12
Option 11: Teria + Cabecera Indio
Total Demand = 56.7 locks/day



ANNEX 3

Table No.1

Insects of Special Interest in Three Watershed of the Western Región of the Canal of Panama.

Table No.1

Insects of Special Interes in Three Watershed of the Western Región of the Canal of Panama.

FAMILY		Cs	Tbr	Ind	MA	VEES	LES	LEI-F	AL	MAN	ONC	PL	TOR	CHA
Culicidae														
	<i>Coquillettidia venezuelensis</i>		x	x										
	<i>Culex coronator</i>		x	x										
	<i>Culex interrogator</i>		x											
	<i>Culex nigripalpus</i>		x					x						
	<i>Culex quinquefasciatus</i>		x											
	<i>Culex vomerifer</i>	x	x	x										
	<i>Culex(Melanoconium) sp</i>	x	x	x										
	<i>Deinocerites pseudes</i>		x											
	<i>Haemagogus argyromeris</i>		x											
	<i>Haemagogus iridicoler</i>		x	x										
	<i>Limatus assuleptus</i>	x												
	<i>Mansonia dyari</i>	x	x			x								
	<i>Mansonia titillans</i>		x											
	<i>Orthopodomyia kumi</i>		x											
	<i>Psorophora albipes</i>		x											
	<i>Psorophora cilipes</i>		x											
	<i>Psorophora cingulata</i>		x											
	<i>Psorophora ferox</i>		x	x										
	<i>Psorophora lineata</i>		x											
	<i>Sabates chlropterus</i>			x			x							
	<i>Sabates undosus</i>		x	x										
	<i>Trichoprosopon cerquera</i>	x												
	<i>Trichoprosopon digitatum</i>	x												
	<i>Trichoprosopon longipes</i>	x	x											
	<i>Uranotaenia lowi</i>	x	x											
	<i>Wyeomyia arthrostigma</i>	x	x											
Psychodidae														
	<i>Lutzomyia adydifera</i>	x	x	x										
	<i>Lutzomyia barretoi</i>		x											
	<i>Lutzomyia camposi</i>	x	x	x										
	<i>Lutzomyia carpenteri</i>	x	x	x										
	<i>Lutzomyia galindoi</i>		x											
	<i>Lutzomyia gomezi</i>	x	x	x					x					
	<i>Lutzomyia harmanni</i>	x		x										
	<i>Lutzomyia nordestina</i>	x	x											
	<i>Lutzomyia olmeca</i>		x						x					
	<i>Lutzomyia panamensis</i>	x	x	x					x					
	<i>Lutzomyia pessoaana</i>		x											
	<i>Lutzomyia runoides</i>	x	x											
	<i>Lutzomyia sanguinaria</i>	x	x	x					x					
	<i>Lutzomyia serrana</i>	x	x											
	<i>Lutzomyia shannoni</i>			x										
	<i>Lutzomyia trapidoi</i>	x	x	x					x					
	<i>Lutzomyia trinidadensis</i>	x												
	<i>Lutzomyia triramula</i>	x	x	x										
	<i>Lutzomyia vesicifera</i>	x	x											
	<i>Lutzomyia vespertilionis</i>			x										
	<i>Lutzomyia ylephiletor</i>		x	x					x					

Table No.1

Insects of Special Interest in Three Watershed of the Western Región of the Canal of Panama.

FAMILY	Cs	Tbr	Ind	MA	VEE	SLE	SLE-FA	LEI	MAN	ONC	PL	TOR	CHA
Ceratopogónidos													
<i>Culicoides furens</i>	X	X	X							X			
<i>Culicoides insignis</i>		X	X										
Simuliidae													
<i>Simulium sanguineum</i>	X	X	X	X						X			
<i>Simulium callidum</i>		X									X		
<i>Simulium metallicum</i>		X	X								X		
<i>Simulium mexicanum</i>		X	X										
<i>Simulium ochraceum</i>		X	X										
<i>Simulium quadrivittatum</i>		X	X							X			
Triatominae													
<i>Panstrongylus geniculatus</i>	X		X							X		X	
<i>Panstrongylus humeralis</i>			X									X	
<i>Panstrongylus rufotuberculatus</i>		X	X									X	
<i>Rhodnius pallescens</i>	X	X	X									X	
Oestridae	Dermatobia hominis	X	X	X								X	

MA: Malaria

MAN: Mansolenosis

Cs: Caño Sucio

VEE: equine Venezuelan encephalitis

ONC: Oncocercosis

Tbr: Tobre

SLE: San Luis encephalitis

PL: Plague

Ind: Indio

SLE/FA: encephalitis

TOR: Plague

LEI: Leishmaniasis

CHA: Chagas Illness

Source: Louis Berger, 2003.

Table No.2

List of Fishes distributed for Hydric Systems in
Three Basin in the Western Región of the Canal Watershed.

Family/Genera	Specie	SHBCL	SHBCR	SHA	SHE	CS	Ind	Tbr
Apocheilidae								
	<i>Rivulus</i> sp.	x		x		x	x	
Atherinidae								
	<i>Atherinella</i> chagresi				x	x	x	
Carangidae								
	<i>Caranx</i> latus		x		x	x		
Characidae								
	<i>Astyanax</i> aeneus	x		x	x	x	x	
	<i>Brycon</i> chagrensis	x		x	x	x	x	x
	<i>Brycon</i> obscurus	x	x	x		x		x
	<i>Bryconamericus</i> emperador	x	x	x	x	x	x	x
	<i>Compsura</i> mitoptera	x	x		x	x	x	x
	<i>Gephyrocharax</i> intermedius	x					x	
	<i>Hypessobrycon</i> panamensis	x	x	x		x	x	x
	<i>Roeboides</i> guatemalensis	x			x	x	x	
	<i>Roeboides</i> sp. nov.		x	x		x		x
Cichlidae								
	<i>Aequidens</i> coeruleopunctatus	x	x	x	x	x	x	x
	<i>Vieja</i> maculicauda		x		x	x	x	
Engraulidae								
	<i>Anchoviella</i> elongata				x	x		
Eleotridae								
	<i>Eleotris</i> amblyopsis		x		x	x	x	
	<i>Eleotris</i> pisonis	x	x		x	x	x	x
	<i>Gobiomorus</i> dormitor	x	x		x	x	x	
Erythrinidae								
	<i>Hoplias</i> microlepis	x						x
Gobiidae								
	<i>Awaous</i> banana	x	x			x	x	x
	<i>Gobionellus</i> sp.		x		x	x	x	
	<i>Sicydium</i> altum	x	x	x	x	x	x	x
Haemulidae								
	<i>Pomadasys</i> crocro	x	x			x	x	x
Lebiasinidae								
	<i>Piabucina</i> panamensis	x		x		x	x	
Loricariidae								
	<i>Ancistrus</i> chagresi		x			x		
	<i>Leptoancistrus</i> canensis			x			x	
	<i>Rineloricaria</i> uracantha	x					x	
Mugilidae								
	<i>Agonostomus</i> monticola	x	x	x	x	x	x	x
	<i>Joturus</i> pichardi	x				x		
Pimelodidae								
	<i>Rhamdia</i> laticauda			x			x	
	<i>Rhamdia</i> quelen			x		x	x	
Poeciliidae								
	<i>Brachyrhaphis</i> cascajalensis	x	x		x	x	x	x
	<i>Brachyrhaphis</i> episcopi	x					x	
	<i>Brachyrhaphis</i> roswithae	x	x	x	x	x	x	x
	<i>Poecilia</i> gillii	x	x	x	x	x	x	

Table No.2
List of Fishes distributed for Hydric Systems in
Three Basin in the Western Región of the Canal Watershed.

Family/Genera	Specie	SHBCL	SHBCR	SHA	SHE	CS	Ind	Tbr
Rhamphichthyidae								
	<i>Brachyhypopomus occidentalis</i>	X	X	X		X	X	
Syngnathidae								
	<i>Pseudophallus mindii</i>				X	X	X	
	<i>Synbranchus marmoratus</i>		X	X		X		
	<i>Microphis brachyurus</i>		X		X	X	X	
Trichomycteridae								
	<i>Trichomycterus striatus</i>	X	X	X		X	X	X

SHBCL:Sistema Hídrico de Bajura de Corriente lenta.

CS:Cano Sucio

SHBCR: Sistema Hídrico de Bajura de Corriente rápida.

TBR: Toabré

SHA: Sistema Hídrico de Altura.

IND: Indio

SHE: Sistema Hídrico Estuarino.

Fuente: Louis Berger, 2003.

Table No. 3

Amphibians and Reptiles by Categories of Habitat, Activity and mode of Detection in three Sub-Basins in Western Region of the Canal of Panama.

Order /Class	Family	Specie	Habitat	Micro	Period of	Site of	Mode of	Caño	Toabré	Indio
			Category	Habitat	Activity	Reprod.	Detection	Sucio		
CLASE AMPHIBIA										
Order ANURA	BUFONIDAE	<i>Atelopus sp.</i>	B	Ts	D	Qu	V		x	
		<i>Bufo coniferus</i>	B	Ts,Mq	N	Qu	V,A	x	x	x
		<i>Bufo haematiticus</i>	B	Ts,Mq	D,N	Qu	V,A	x	x	x
		<i>Bufo marinus</i>	AB	Ts,Ch,Mq	N	Qu	V,A	x	x	x
		<i>Bufo typhonius</i>	B	Ts,Mq,Ch	D	Qu	V,A	x	x	x
	CENTROLENIDAE	<i>Centrolene prosoblepon</i>	B	Aa,Mq	N	Qu	V,A	x	x	x
		<i>Cochranella albomaculata</i>	B	Aa, Mq	N	Qu	V,A		x	x
		<i>Cochranella granulosa</i>	B	Aa,Mq	N	Qu	V,A	x	x	x
		<i>Cochranella spinosa</i>	B	Aa,Mq	N	Qu	V,A	x	x	x
		<i>Hyalinobatrachium Chirripoi</i>	B	Aa, Mq	N	Qu	V,A		x	
	DENDROBATIDAE	<i>Hyalinobatrachium colymbiphyllum</i>	B	Aa,Mq	N	Qu	V,A	x	x	
		<i>Hyalinobatrachium fleischmanni</i>	B	Aa,Mq	N	Qu	V,A	x	x	x
		<i>Hyalinobatrachium pulveratum</i>	B	Aa,Mq	N	Qu	V,A		x	x
		<i>Hyalinobatrachium vireovittatum</i>	B	Aa,Mq	N	Qu	V,A	x	x	x
		<i>Colostethus flotator</i>	B	Ts	D	Qu*	V,A	x	x	x
	HYLIDAE	<i>Colostethus inguinalis</i>	B	Ts,Mq	D	Qu*	V,A	x	x	x
		<i>Colostethus nubicola</i>	B	Ts	D	Qu*	V,A	x	x	x
		<i>Colostethus pratti</i>	B	Ts	D	Qu*	V,A	x	x	x
		<i>Colostethus talamancae</i>	B	Ts	D	Qu*	V,A	x	x	x
		<i>Dendrobates auratus</i>	B	Ts	D	Aca*,Ac*	V	x	x	
		<i>Dendrobates minutus</i>	B	Ts	D	Aca*,Ac*?	V,E	x	x	x
		<i>Phyllobates lugubris</i>	B	Ts,Mq	D	Ac*	V,A	x	x	x
	HYLIDAE	<i>Agalychnis callidryas</i>	AB	Aa,Ah,Ch	N	Po	V,A,I	x	x	x
		<i>Gastrotheca cornuta</i>	B	Aa, Mq	N	Ma	V,A			x
		<i>Hyla crepitans</i>	A	Ah,Ts,Ch	N	Po	V,A	x		x
		<i>Hyla ebraccata</i>	AB	Ah,Ch	N	Po	V,A	x	x	x
		<i>Hyla microcephala</i>	A	Ah,Ch	N	Po	V,A	x		x
		<i>Hyla palmeri</i>	B	Aa, Mq	N	Qu	V,A			x
		<i>Hyla phlebodes</i>	AB	Ah,Ch	N	Po	V,A	x	x	x
	HYLIDAE	<i>Hyla rufitela</i>	B	Aa,Mq	N	Po,Qu	V,A	x	x	x
		<i>Phrynohyas venulosa</i>	AB	Aa,Ch,Mq	N	PO	F,A			x
		<i>Scinax boulengeri</i>	A	Ah,Aa,Ch	N	Po	V,A	x	x	x
		<i>Scinax rostrata</i>	A	Ah,Aa,Ch	N	Po	V,A			x
		<i>Scinax rubra</i>	A	Ah, Ch	N	Po	V,A,E			x
		<i>Smilisca phaeota</i>	AB	Ah,Ch	N	Po	V,A	x	x	x

Order /Class	Family	Species	Habitat	Micro	Period of	Site of	Mode of	Caño	Toabré	Indio
			Category	Habitat	Activity	Reprod.	Detection	Sucio		
Order ANURA	LEPTODACTYLIDAE	<i>Smilisca sila</i>	B	Ah,Mq	N	Qu	V,A,E	x	x	x
		<i>Eleutherodactylus bransfordii</i>	B	Ts	D	Te	V	x	x	x
		<i>Eleutherodactylus bufoniformis</i>	B	Ts,Mq	N	Te	V	x	x	x
		<i>Eleutherodactylus caryophyllaceus</i>	B	Aa,Ts?	N	Ar	V	x		x
		<i>Eleutherodactylus cerasinus</i>	B	Ts,Aa	N	Te	V	x	x	x
		<i>Eleutherodactylus crassidigitus</i>	B	Ts	N	Te	V	x	x	x
		<i>Eleutherodactylus cruentus</i>	B	Ts,Aa	N	Te,Ar	V	x	x	x
		<i>Eleutherodactylus diastema</i>	AB	Aa	N	Ar	V,A	x	x	x
		<i>Eleutherodactylus fitzingeri</i>	B	Ts,Aa	N	Te	V,A	x	x	x
		<i>Eleutherodactylus gaigei</i>	B	Ts,Mq	N	Te	V	x	x	x
		<i>Eleutherodactylus gollmeri</i>	B	Ts	D?	Te	V	x	x	x
		<i>Eleutherodactylus grupo diastema</i>	AB	Aa	N	Ar?	V,A	x	x	x
		<i>Eleutherodactylus megacephalus</i>	B	Ts,Mq	D,N	Te	V	x	x	x
		<i>Eleutherodactylus museosus</i>	B	Aa	N	Ar?	V			x
		<i>Eleutherodactylus pardalis</i>	B	Aa	N	Ar?	V	x		x
		<i>Eleutherodactylus punctariolus</i>	B	Ts,Mq	N	Te	V	x		x
		<i>Eleutherodactylus ridens</i>	B	Ts,Aa	N	Te?,Ar?	V,A	x	x	x
		<i>Eleutherodactylus taeniatus</i>	B	Aa,Ts	N	Ar?,Te?	V,A	x	x	x
		<i>Eleutherodactylus talamancae</i>	B	Ts,Aa	N	Te	V	x	x	x
		<i>Eleutherodactylus vocator (TA)</i>	B	Ts,Aa	N	Te?,Ar?	V,A	x	x	x
		<i>Eleutherodactylus vocator (TB)</i>	B	Ts	D	Te?	V,A	x	x	x
		<i>Leptodactylus insularum</i>	A	Ts,Ch	N	Po	V,A	x	x	x
		<i>Leptodactylus labialis</i>	A	Ts,Ch	N,D	Po	V,A	x	x	x
		<i>Leptodactylus melanotonus</i>	AB	Ts,Ch,Mq	N,D	Po,Qu	V,A	x	x	x
		<i>Leptodactylus pentadactylus</i>	AB	Ts,Ch,Mq	N	Po,Qu	V,A	x	x	x
		<i>Leptodactylus poecilochilus</i>	AB	Ts,Ch	N	Po	V,A	x	x	x
		<i>Physalaemus pustulosus</i>	AB	Ts,Ch,Mq	N,D	Po,Qu	V,A	x	x	x
Order ANURA	MICROHYLIDAE	<i>Chiamocleis panamensis</i>								x
	RANIDAE	<i>Rana vaillanti</i>	AB	Ts,Ch,Mq	N	Po,Qu	V,A	x	x	x
		<i>Rana warszewitschii</i>	B	Ts,Mq	D	Qu	V,E		x	x
Order CAUDATA	PLETHODONTIDAE	<i>Bolitoglossa biseriata</i>	B	Aa	N	Te	V,E	x	x	x
		<i>Bolitoglossa schizodactyla</i>	B	Aa	N	Te	V	x		x
		<i>Oedipina collaris</i>	B	Ts,Mq,Tm?	N	Te	V	x	x	x
		<i>Oedipina parvipes</i>	B	Ts,Tm?	N?	Te	V	x	x	x
Order CROCODYLIA	ALLIGATORIDAE	<i>Caiman crocodilus</i>	AB	Sa	N,D	Nm	V,I	x	x	x
	ANGUIDAE	<i>Diploglossus monotropis</i>	B	Ts	D	Te	V	x		
	CORYTOPHANIDAE	<i>Basiliscus basiliscus</i>	B	Ts,Aa,Mq	D	Te	V	x	x	x
		<i>Corytophanes cristatus</i>	B	Aa	D	Te	V		x	x
	GEKKONIDAE	<i>Gonatodes albogularis</i>	ABR	Aa,Ts,Zh	D	Ed,Ar	V			x
		<i>Hemidactylus frenatus</i>	R	Zh	N	Ed	V,A			x

Order /Class	Family	Specie	Habitat Category	Micro Habitat	Period of Activity	Site of Reprod.	Mode of Detection	Caño Suci	Toabré	Indio
Order SQUAMATA	GYMNOPHTHALMIDAE	<i>Lepidoblepharis xanthostigma</i>	B	Ts	D	Te	V	x		x
		<i>Sphaerodactylus lineolatus</i>							x	x
	GYMNOPHTHALMIDAE	<i>Leposoma southi</i>	B	Ts	D	Te	V	x	x	x
	HOPLOCERCIDAE	<i>Enyaliooides heterolepis</i>	B	Ts	D	Te	V		x	
	IGUANIDAE	<i>Iguana iguana</i>	AB	Aa,Ts	D	Te	V,I	x	x	x
	POLYCHROTIDAE	<i>Anolis auratus</i>	A	Ah	D	Te	V,I		x	x
		<i>Anolis capito</i>	B	Ts	D	Te	V,T	x	x	x
		<i>Anolis frenatus</i>	B	Aa	D	Ar?	V,I	x	x	x
		<i>Anolis humilis</i>	B	Ts	D	Te	V,E	x	x	x
		<i>Anolis limifrons</i>	AB	Ts,Aa	D	Te	V,T	x	x	x
		<i>Anolis lionotus</i>	B	Ts,Mq	D	Te	V,E	x	x	x
		<i>Anolis</i> sp. (no descrita)	B	Ts,Aa	D	Te?	V	x		
		<i>Anolis vittigerus</i>	AB	Aa	D	Ar	V,E		x	x
	SCINCIDAE	<i>Mabuya unimarginata</i>	AR	Ts	D	Vi	V	x		x
	TEIIDAE	<i>Ameiva ameiva</i>	A	Ts	D	Te	V	x	x	x
		<i>Ameiva festiva</i>	B	Ts	D	Te	V,T	x	x	x
		<i>Ameiva leptophrys</i>	B	Ts	D	Te	V,T		x	x
SUBOrder SERPENTES	BOIDAE									
		<i>Corallus annulatus</i>	B	Aa	N	Vi	V	x		
SUBOrder SERPENTES	COLUBRIDAE	<i>Chironius carinatus</i>	B	Ts,Aa	D	Te?,Ar?	V	x	x	
		<i>Chironius exoletus</i>	B	Ts,Aa	D	Te?,Ar?	V	x		
		<i>Chironius grandisquamis</i>	B	Ts,Aa	D	Te?,Ar?	V	x		
		<i>Dendrophidion percarinatum</i>	B	Ts	D	Te	V	x	x	
		<i>Dipsas articulata</i>	B	Ts,Aa	N	Ar?	V	x		
		<i>Dryadophis melanolomus</i>	AB	Ts,Ah	D	Te	V	x		x
		<i>Enuliophis sclateri</i>	B	Ts,Tm?	N	Te	V	x		
		<i>Erythrolamprus bizona</i>	AB	Ts	D	Te	V		x	
		<i>Imantodes cenchoa</i>	B	Aa	N	Ar?	V,I	x	x	x
		<i>Leptodeira annulata</i>	AB	Ts	N	Te	V			x
		<i>Leptodeira septentrionalis</i>	B	Ts,Aa	N	Te?	V	x		
		<i>Leptophis ahaetula</i>	B	Aa,Ts	D	Ar	V,F			x
		<i>Liophis epinephelus</i>	B	Ts	D	Te	V,E	x	x	
		<i>Pseustes poecilonotus</i>	AB	Ts,Aa?	D	Te?	V,F			x
		<i>Rhadinaea decorata</i>	B	Ts	D	Te	V	x		
		<i>Sibon nebulatus</i>	B	Aa	N	Ar?	V	x	x	x
		<i>Spilotes pullatus</i>	B	Ts,Aa	D	Te,Ar?	V,I			x
		<i>Urotheca euryzona</i>	B	Ts	N	Te	V			x
		<i>Urotheca fulviceps</i>	B	Ts	N,D	Te	V			x
		<i>Xenodon rabdocephalus</i>	AB	Ts	D	Te	V			x
	ELAPIDAE	<i>Micrurus mipartitus</i>	AB	Ts,Tm	N,D	Te	E			x

Order /Class	Family	Specie	Habitat	Micro	Period of	Site of	Mode of	Caño	Toabré	Indio
			Category	Habitat	Activity	Reprod.	Detection	Sucio		
	VIPERIDAE	<i>Micrurus stewarti</i>	AB	Ts,Tm	N	Te	V	x	x	x
		<i>Bothriechis schlegelii</i>	B	Aa	N	Vi	V	x		
		<i>Bothrops asper</i>	AB	Ts	N,D	Vi	V,E,I	x	x	x
		<i>Lachesis stenophrys</i>	B	Ts	N	Te	I,E	x		
		<i>Porthidium nasutum</i>	B	Ts	N	Vi	V	x		
Order TESTUDINES	CHELYDRIDAE	<i>Chelydra acutirostris</i>	S	Sa	D	Nm	T	x		
	KINOSTERNIDAE	<i>Kinosternon leucostomum</i>	SAB	Sa	N	Nm	V,T	x	x	x

A:open area, forest

Aa: Arboreal

Tm:Terrestrial soil/fallen leaves

Qu;quebrada

B: Forest

Ah: lower vegetation

Zh: Inhabited zones

Po:l puddles

R: humane housing

Ch: Charcas

D:Diurnal; N: nocturne

F:foto

S: Aquatic or Semiaquat.

Sa: Aquatic to semiaquatic

Ar:arboreal; Ed:buildings

Te:terrestrial

Ac:water accumulate

Aca: tree accumulation

Ma:eggs y larvae in purse

T:traps

I:informant; Nm:nest near to water

Vi:vivipare

V:visual

Tm:Terrestrial mining

A:acustic

E:specimen

Source:Louis Berger, 2003.

Table No. 4
**List of Amphibians and Reptiles of Special Interest in three
 Basins of the Western Región of the Canal Watershed**

Class	Family	Genera	Species	VU	EP	END	IC	AM	CITES	PH	CO	Caño Sucio	Toabré	Indio
Reptilia	Dendrobatidae	<i>Eleutherodactylus</i>	<i>pardalis</i>	X				X				1		1
		<i>Eleutherodactylus</i>	<i>punctariolus</i>			X						1	1	1
		<i>Eleutherodactylus</i>	<i>vocator (de tierras altas)</i>				X					1	1	1
		<i>Eleutherodactylus</i>	<i>vocator (de tierras bajas)</i>				X					1	1	1
		<i>Leptodactylus</i>	<i>insularum</i>					X				1	1	1
		<i>Leptodactylus</i>	<i>pentadactylus</i>							X	1	1	1	
		<i>Phyllobates</i>	<i>lugubris</i>		X				II			1	1	
	Plethodontidae													
		<i>Bolitoglossa</i>	<i>biseriata</i>	X								1	1	1
		<i>Bolitoglossa</i>	<i>schizodactyla</i>	X	X							1		1
		<i>Oedipina</i>	<i>collaris</i>		X							1	1	
	Ranidae													
		<i>Rana</i>	<i>vaillanti</i>							X	1	1	1	
Reptilia	Alligatoridae													
		<i>Caiman</i>	<i>crocodilus</i>					X		X	1	1	1	
	Anguidae													
		<i>Diploglossus</i>	<i>monotropis</i>	X							1			
	Bataguridae													
		<i>Rhinoclemmys</i>	<i>funerea</i>						X				1	
	Boidae													
		<i>Corallus</i>	<i>annulatus</i>						II		1			
	Chelydridae													
		<i>Chelydra</i>	<i>acutirostris</i>	X						X	1			
	Colubridae													
		<i>Leptodeira</i>	<i>annulata</i>					X						1
		<i>Leptodeira</i>	<i>septentrionalis</i>					X			1			
		<i>Dipsas</i>	<i>articulata</i>	X							1			
		<i>Sibon</i>	<i>argus</i>	X										1
		<i>Sibon</i>	<i>annulatus</i>						X			1		
		<i>Urotheca</i>	<i>euryzona</i>										1	
		<i>Urotheca</i>	<i>fulviceps</i>	X		X							1	
		<i>Xenodon</i>	<i>rabocephalus</i>	X								1	1	
	Corytophanidae													
		<i>Basiliscus</i>	<i>basiliscus</i>							X	1	1	1	

Class	Family	Genera	Species	VU	EP	END	IC	AM	CITES	PH	CO	Caño Sucio	Toabré	Indio
Elapidae	Elapidae	<i>Bothriechis</i>	<i>schlegelii</i>							X		1		
		<i>Micrurus</i>	<i>stewarti</i>			X	X			X		1	1	1
		<i>Micrurus</i>	<i>mipartitus</i>							X				1
Gekkonidae	Gekkonidae													
		<i>Hemidactylus</i>	<i>frenatus</i>											1
Gymnophthalmidae	Gymnophthalmidae	<i>Leposoma</i>	<i>southi</i>						X			1	1	1
Iguanidae	Iguanidae								II			1	1	1
		<i>Iguana</i>	<i>iguana</i>		X									
Polychrotidae	Polychrotidae													
		<i>Anolis</i>	<i>lionotus</i>		X	X		X				1		1
		<i>Anolis</i>	<i>insignis</i>		X			X						1
		<i>Anolis</i>	<i>sp. (no descrita)</i>					X						1
		<i>Anolis</i>	<i>lionotus</i>			X								1
		<i>Anolis</i>	<i>vittigerus</i>					X						1
Teiidae	Teiidae													
		<i>Ameiva</i>	<i>leptophrys</i>					X						1
Viperidae	Viperidae													
		<i>Bothrops</i>	<i>asper</i>							X		1	1	1
		<i>Lachesis</i>	<i>stenophrys</i>							X		1		
		<i>Porthidium</i>	<i>nasutum</i>							X		1		

VU: Vulnerable

AM: Threatened

EP: Endangered

CITES II: Appendix 2 of species no listed how endangered

END: Endemic

PH: Endangered to the man

IC:Scientific Interes

CO: Edible

Source: Louis Berger, 2003.

Table No. 5 General list of Birds Reported in Caño Sucio, Toabre and Indio Rivers watershed

Order	Family	Specie	AIE	AIG	Caño Sucio	Toabré	Indio
Apodiformes							
	Apodidae						
		<i>Chaetura spinicauda</i>	*	*	X	X	X
		<i>Streptoprocne zonaris</i>	*	*	X	X	X
	Trochilidae						
		<i>Amazilia amabilis</i>	*			X	X
		<i>Amazilia edward</i>	*	*	X	X	
		<i>Amazilia tzacatl</i>	*	*	X	X	X
		<i>Anthracothorax nigricollis</i>	*	*	X		X
		<i>Chalybura buffoni</i>	*	*	X	X	X
		<i>Chalybura urochrysia</i>	*	*	X	X	X
		<i>Chlorostilbon assimilis</i>	*	*	X	X	X
		<i>Damophila julie</i>	*	*	X	X	X
		<i>Eutoxeres aquila</i>	*	*		X	X
		<i>Florisuga mellivora</i>	*	*	X	X	X
		<i>Glaucis hirsuta</i>	*	*	X	X	X
		<i>Heliodoxa jacula</i>		*		X	X
		<i>Lepidopyga coeruleogularis</i>	*		X	X	
		<i>Phaethornis guy</i>	*	*	X	X	X
		<i>Phaethornis longuemareus</i>	*	*	X	X	X
		<i>Phaethornis superciliosus</i>	*	*	X	X	X
		<i>Thalurania colombica</i>	*	*	X	X	X
		<i>Threnetes ruckeri</i>	*	*	X	X	X
	Jacanidae						
		<i>Jacana jacana</i>	*				X
Ciconiiformes							
	Ardeidae						
		<i>Ardea alba</i>	*		X	X	X
		<i>Bubulcus ibis</i>	*	*	X	X	X
		<i>Egretta caerulea</i>	*	*		X	X
		<i>Egretta thula</i>	*			X	X
		<i>Tigrisoma lineatum</i>	*		X		
	Cathartidae						
		<i>Cathartes aura</i>	*	*	X	X	X
		<i>Coragyps atratus</i>	*	*	X	X	X
		<i>Sarcoramphus papa</i>	*			X	
Columbiformes							
	Columbidae						
		<i>Claravis pretiosa</i>	*			X	
		<i>Columba cayennensis</i>					
		<i>Columba livia</i>	*				X
		<i>Columba nigrirostris</i>	*	*	X	X	X
		<i>Columba speciosa</i>	*	*		X	X
		<i>Columba subvinacea</i>		*		X	X
		<i>Columbina talpacoti</i>	*	*	X	X	X
Columbiformes	Columbidae	<i>Geotrygon chiriquensis</i>		*		X	X
		<i>Geotrygon lawrenci</i>	*			X	

Order	Family	Species	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Geotrygon montana</i>	*	*	X	X	X
		<i>Leptotila cassini</i>	*	*	X	X	X
		<i>Leptotila verreauxi</i>	*	*	X	X	X
Coraciiformes	Alcedinidae						
		<i>Ceryle torquata</i>	*	*	X	X	X
		<i>Chloroceryle aenea</i>	*			X	
		<i>Chloroceryle aenea</i>	*			X	
	Bucconidae						
		<i>Malacoptila panamensis</i>	*	*	X	X	X
		<i>Nonnula ruficapilla</i>	*		X	X	X
		<i>Notharchus pectoralis</i>	*		X	X	X
	Galbulidae	<i>Nystalus radiatus</i>	*	*	X	X	X
		<i>Jacamerops aurea</i>	*			X	
	Momotidae						
		<i>Baryphthengus martii</i>	*	*	X	X	X
		<i>Electron platyrhynchum</i>	*	*	X	X	X
	Picidae	<i>Momotus momota</i>	*				X
		<i>Campephilus melanoleucus</i>	*		X	X	X
		<i>Dryocopus lineatus</i>	*	*	X	X	X
		<i>Melanerpes pucherani</i>	*	*	X	X	X
	Ramphastidae	<i>Melanerpes rubricapillus</i>	*	*	X	X	X
		<i>Aulacorhynchus prasinus</i>		*			X
		<i>Capito maculicoronatus</i>	*	*	X	X	X
		<i>Pteroglossus torquatus</i>	*	*	X	X	X
		<i>Ramphastus sulfuratus</i>	*	*	X	X	X
		<i>Ramphastus swainsoni</i>	*	*	X	X	
		<i>Selenidea spectabilis</i>		*			X
		<i>Semnornis frantzii</i>	*				X
Cuculiformes	Cuculidae						
		<i>Crotophaga ani</i>	*	*	X	X	X
		<i>Crotophaga major</i>	*	*	X		X
		<i>Piaya cayana</i>	*	*	X	X	X
	Falconiformes	<i>Tapera naevia</i>	*	*	X	X	X
		<i>Buteo magnirostris</i>	*				X
		<i>buteo platypterus</i>		*			X
		<i>Elanoides forficatus</i>	*	*	X	X	X
		<i>Gampsonyx swaisonii</i>	*				X
		<i>Elanus leucurus</i>	*			X	
		<i>Harpagus bidentatus</i>	*	*	X		X
		<i>Ictinia plumbea</i>	*		X	X	X
		<i>Leucopternis albicollis</i>		*			X

Order	Family	Specie	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Leucopternis plumbea</i>	*		x	x	x
		<i>Leucopternis semiplumbea</i>	*	*	x	x	
		<i>Spizaetus tyrannus</i>	*			x	x
	Falconidae						
		<i>Caracara plancus</i>				x	x
		<i>Micrastur ruficollis</i>	*	*	x	x	x
		<i>Milvago chimachima</i>	*	*	x	x	x
Galliformes	Cracidae						
		<i>Chamaepetes unicolor</i>		*		x	x
		<i>Crax rubra</i>	*			x	
		<i>Ortalis cinereiceps</i>	*	*	x	x	x
		<i>Penelope purpurascens</i>	*			x	
	Odontophoridae						
		<i>Odontophorus gujanensis</i>	*			x	
		<i>Odontophorus leucolaemus</i>	*			x	
	Eurypygidae						
		<i>Eurypyga helias</i>	*	*		x	
Gruiformes	Rallidae						
		<i>Aramides cajanea</i>	*	*	x	x	x
Passeriformes	Cardinalidae						
		<i>Caryothraustes poliogaster</i>	*			x	
		<i>Cyanocompsa cyanoides</i>	*	*	x	x	x
		<i>Saltator albicollis</i>		*		x	x
		<i>Saltator atriceps</i>	*	*	x	x	x
		<i>Saltator maximus</i>	*	*	x	x	x
		<i>Saltator striatipectus</i>	*	*	x	x	x
	Coerebidae						
		<i>Coereba flaveola</i>	*	*	x	x	x
	Corvidae						
		<i>Cyanocorax affinis</i>	*	*	x	x	x
	Cotingidae						
		<i>Querula purpurata</i>	*	*	x	x	x
	Dendrocolaptidae						
		<i>Deconychura longicauda</i>	*	*	x	x	
		<i>Dendrocincla fuliginosa</i>	*	*	x	x	x
		<i>Glyphorynchus spirurus</i>	*	*	x	x	x
		<i>Sittasomus griseicapillus</i>	*	*	x	x	
		<i>Xiphorhynchus susurrans</i>	*	*	x	x	x
	Emberizidae						
		<i>Arremon aurantiirostris</i>	*	*	x	x	x
		<i>Arremonops conirostris</i>	*	*	x	x	x
		<i>Oryzoborus funereus</i>	*	*	x	x	x
		<i>Sporophila americana</i>	*	*	x	x	x
Passeriformes	Emberizidae	<i>Sporophila nigricollis</i>		*		x	x
		<i>Sporophila schistacea</i>	*	*	x		
		<i>Tiaris olivacea</i>	*			x	

Order	Family	Species	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Volatinia jacarina</i>	*	*	X	X	X
	Formicariidae						
		<i>Formicarius analis</i>	*	*	X	X	X
		<i>Grallaria guatimalensis</i>	*			X	
		<i>Hylopezu perspicillatus</i>	*			X	
		<i>Pittasoma michleri</i>	*			X	
	Furnariidae						
		<i>Automolus ochrolaemus</i>	*	*	X	X	X
		<i>Xenops minutus</i>	*	*	X	X	X
		<i>Xenops rutilans</i>		*		X	X
	Hirundinidae						
		<i>Hirundo rustica</i>		*			X
		<i>Progne chalybea</i>	*			X	
		<i>Pygochelidon tibialis</i>		*			X
		<i>Stelgidopteryx ruficollis</i>	*	*	X	X	X
	Icteridae						
		<i>Amblycercus holosericeus</i>	*	*	X	X	X
		<i>Cacicus cela</i>	*	*	X	X	X
		<i>Cacicus uropygialis</i>	*	*	X	X	X
		<i>Icterus chrysater</i>	*	*	X	X	X
		<i>Icterus dominicensis</i>	*			X	
		<i>Icterus galbula</i>	*			X	
		<i>Psarocolius decumanus</i>	*		X	X	
		<i>Psarocolius wagleri</i>	*	*	X	X	X
		<i>Psarocolius montezuma</i>	*	*	X	X	
		<i>Scaphidura oryzivora</i>	*		X		X
		<i>Sturnella magna</i>	*	*	X		
	Mimidae						
		<i>Mimus gilvus</i>	*			X	
	Parulidae						
		<i>Basileuterus fulvicauda</i>	*	*	X	X	X
		<i>Basileuterus rufifrons</i>	*	*		X	X
		<i>Dendroica castanea</i>	*	*		X	X
		<i>Dendroica pensylvanica</i>	*	*	X	X	X
		<i>Dendroica petechia</i>	*	*	X	X	X
		<i>Geothlypis trichas</i>	*	*		X	X
		<i>Mniotilla varia</i>	*	*		X	X
		<i>Oporornis agilis</i>	*		X		X
		<i>Oporornis formosus</i>	*	*	X		X
		<i>Oporornis philadelphica</i>		*	X	X	X
		<i>Protonotaria citrea</i>		*	X		X
		<i>Seiurus motacilla</i>	*	*		X	X
		<i>Seiurus novaboracensis</i>	*	*	X	X	X
		<i>Vermivora chrysoptera</i>		*		X	X
		<i>Vermivora peregrina</i>	*	*	X	X	X
Passeriformes	Parulidae	<i>Wilsonia citrina</i>		*	X		X
	Pipridae						-
		<i>Corapipo altera</i>	*	*		X	X

Order	Family	Specie	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Manacus vitellinus</i>	*	*	X	X	X
		<i>Pipra coronata</i>	*	*	X	X	
		<i>Pipra mentalis</i>	*	*	X	X	X
	Sylviidae						
		<i>Microbates cinereiventris</i>	*	*	X		X
		<i>Polioptila plumbea</i>	*	*	X	X	
		<i>Ramphocaenus melanurus</i>	*	*	X	X	X
	Thamnophilidae						
		<i>Cercomacra nigricans</i>	*		X	X	X
		<i>Cercomacra tyrannina</i>	*	*	X	X	X
		<i>Cymbilaimus lineatus</i>	*	*	X	X	X
		<i>Dysithamnus mentalis</i>	*	*		X	X
		<i>Dysithamnus punticeps</i>		*	X		
		<i>Gymnocichla nudiceps</i>	*	*	X	X	
		<i>Gymnopithys leucaspis</i>	*	*	X	X	X
		<i>Hylophylax naevioides</i>	*	*	X	X	X
		<i>Microrhopias quixensis</i>	*	*	X	X	X
		<i>Myrmeciza exsul</i>	*	*	X	X	X
		<i>Myrmeciza immaculata</i>	*		X	X	
		<i>Myrmeciza longipes</i>	*	*	X	X	X
		<i>Myrmotherula axillaris</i>	*	*	X	X	X
		<i>Myrmotherula fulviventris</i>	*	*	X	X	X
		<i>Myrmotherula schisticolor</i>					X
		<i>Thamnophilus atrinucha</i>	*	*	X	X	X
		<i>Thamnophilus doliatus</i>		*			X
		<i>Taraba major</i>	*	*			X
	Thraupidae						
		<i>Chlorophanes spiza</i>	*	*	X	X	X
		<i>Cyanerpes cyaneus</i>	*	*	X	X	X
		<i>Dacnis cayana</i>	*	*	X	X	X
		<i>Euphonia anneae</i>	*	*		X	X
		<i>Euphonia fulvicrissa</i>	*	*	X	X	
		<i>Euphonia laniirostris</i>	*	*	X	X	X
		<i>Euphonia luteicapilla</i>	*	*	X	X	X
		<i>Habia fuscicauda</i>	*	*	X	X	X
		<i>Habia rubica</i>		*	X		X
		<i>Mitrospingus cassinii</i>	*	*	X	X	X
		<i>Piranga flava</i>		*			X
		<i>Piranga rubra</i>	*	*		X	X
		<i>Ramphocelus dimidiatus</i>	*	*	X	X	X
		<i>Ramphocelus flammigerus</i>	*	*	X	X	X
		<i>Rhodinicichla rosea</i>	*	*	X	X	
		<i>Tachyphonus delatrii</i>	*	*	X	X	X
		<i>Tachyphonus luctuosus</i>	*	*	X	X	X
		<i>Tachyphonus rufus</i>	*	*	X	X	
		<i>Tangara florida</i>		*			X
Passeriformes	Thraupidae	<i>Tangara gyrola</i>		*	X		X
		<i>Tangara inornata</i>	*	*	X	X	X
		<i>Tangara larvata</i>	*	*	X	X	X

Order	Family	Species	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Thraupis episcopus</i>	*	*	X	X	X
		<i>Thraupis palmarum</i>	*	*	X	X	X
	Troglodytidae						
		<i>Campylorhynchus albostriatus</i>	*				X
		<i>Cyphorhinus phaeocephalus</i>	*	*	X	X	X
		<i>Henicorhina leucosticta</i>	*	*	X	X	X
		<i>Microcerulus marginatus</i>	*	*	X	X	X
		<i>Thryothorus fasciatoventris</i>	*	*	X	X	X
		<i>Thryothorus leucotis</i>		*			X
		<i>Thryothorus modestus</i>	*	*		X	X
		<i>Thryothorus nigricapillus</i>	*	*	X	X	X
		<i>Troglodytes aedon</i>	*	*	X	X	X
	Turdidae						
		<i>Catharus fuscater</i>	*				X
		<i>Catharus ustulatus</i>	*	*	X		X
		<i>Turdus grayi</i>	*	*	X	X	X
		<i>Turdus obsoletus</i>		*	X		
	Tyrannidae						
		<i>Attila spadiceus</i>	*	*	X	X	X
		<i>Camptostoma obsoletum</i>	*	*			X
		<i>Capsiempis flaveola</i>		*			X
		<i>Cnemidocetes subbrunneus</i>	*	*	X	X	X
		<i>Colonia colonus</i>	*	*	X	X	X
		<i>Contopus cinereus</i>	*	*		X	X
		<i>Contopus virens</i>	*	*	X	X	X
		<i>Elaenia chiriquensis</i>		*			X
		<i>Elaenia flavogaster</i>	*	*		X	X
		<i>Elaenia frantzii</i>		*			X
		<i>Empidonax flaviventris</i>		*	X	X	X
		<i>Empidonax traillii</i>		*			X
		<i>Empidonax virescens</i>	*	*	X	X	X
		<i>Lophotriccus pileatus</i>		*			X
		<i>Megarhynchus pitangua</i>	*	*	X		X
		<i>Mionectes oleagineus</i>	*	*	X	X	X
		<i>Mionectes olivaceus</i>	*	*	X	X	X
		<i>Myiarchus crinitus</i>	*	*		X	X
		<i>Myiarchus panamensis</i>	*		X	X	X
		<i>Myiarchus tuberculifer</i>		*			X
		<i>Myiobius atricaudus</i>	*	*	X	X	X
		<i>Myiodynastes maculatus</i>	*	*	X	X	X
		<i>Myiozetetes cayanensis</i>	*			X	X
		<i>Myiozetetes similis</i>	*	*	X	X	X
		<i>Oncostoma olivaceum</i>	*	*	X	X	X
		<i>Onychorhynchus coronatus</i>	*	*	X		X
Passeriformes	Tyrannidae	<i>Ornithion brunneicapillum</i>	*			X	X
		<i>Pachyramphus albogriseus</i>				X	X
		<i>Pachyramphus cinnamomeus</i>	*	*	X	X	X
		<i>Pitangus sulphuratus</i>	*	*	X	X	X

Order	Family	Specie	AIE	AIG	Caño Sucio	Toabré	Indio
		<i>Platyrinchus mystaceus</i>	*	*	x	x	x
		<i>Rhynchocyclus olivaceus</i>	*	*	x	x	x
		<i>Rhytipterna holerythra</i>	*		x		
		<i>Schiffornis turdinus</i>		*		x	x
		<i>Terenotriccus erythrurus</i>	*	*	x	x	x
		<i>Tityra inquisitor</i>	*		x		
		<i>Tityra semifasciata</i>	*	*	x	x	x
		<i>Todirostrum cinereum</i>	*	*	x	x	x
		<i>Tyrannus elatus</i>	*	*			x
		<i>Tyrannus melancholicus</i>	*	*	x	x	x
		<i>Zimmerius vilissimus</i>	*	*	x	x	x
	Vireonidae						
		<i>Hylophilus decurtatus</i>	*	*	x	x	x
		<i>Hylophilus flavipes</i>	*	*	x	x	x
		<i>Vireo flavifrons</i>		*			x
		<i>Vireo flavoviridis</i>	*	*		x	x
		<i>Vireo olivaceus</i>	*	*	x	x	
		<i>Vireolanius pulchellus</i>	*	*	x	x	
Psittaciformes	Psittacidae						
		<i>Amazona autumnalis</i>	*		x	x	x
		<i>Amazona ochrocephala</i>	*	*	x		x
		<i>Brotogeris jugularis</i>	*	*	x	x	x
		<i>Pionus menstruus</i>	*	*	x	x	x
Strigiformes	Caprimulgidae						
		<i>Nyctidromus albicollis</i>	*	*	x	x	x
	Strigidae						
		<i>Ciccaba virgata</i>	*	*	x	x	x
	Nyctibiidae						
		<i>Nyctibius grandis</i>	*		x		
		<i>Nyctibius griseus</i>	*	*	x		x
Tinamiformes	Tinamidae						
		<i>Crypturellus soui</i>	*	*	x	x	x
		<i>Tinamus major</i>	*	*	x	x	x
Trogoniformes	Trogonidae						
		<i>Trogon aurantiventris</i>		*			x
		<i>Trogon clathratus</i>	*	*		x	x
		<i>Trogon massena</i>	*	*	x	x	x
		<i>Trogon rufus</i>	*	*	x	x	x
		<i>Trogon violaceus</i>	*			x	x
		<i>Trogon viridis</i>	*	*	x	x	x

AIE: Specific Interes Area

AIG: Interes General Area

Source: Louis Berger, 2003.

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
Apodiformes										
	Trochilidae									
	<i>Amazilia amabilis</i>	II								
	<i>Amazilia edward</i>	V	II				X	X	X	
	<i>Amazilia tzacatl</i>		II				X	X	X	
	<i>Anthracothorax nigricollis</i>		II				X	X	X	
	<i>Campylopterus hemileucurus</i>		II	N3						
	<i>Colibri delphinae</i>	II	N2		X					
	<i>Chalybura buffoni</i>	II					X	X	X	
	<i>Chalybura urochrysia</i>		II	N3			X	X	X	
	<i>Chlorostilbon assimilis</i>	V	II				X	X	X	
	<i>Damophila julie</i>		II	N3			X	X	X	
	<i>Eupherusa nigriventris</i>	E	II	N2						
	<i>Eutoxeres aquila</i>		II	N3			X	X	X	
	<i>Florisuga mellivora</i>		II				X	X	X	
	<i>Glaucis hirsuta</i>		II				X	X	X	
	<i>Heliodoxa jacula</i>		II	N3			X	X	X	
	<i>Heliothryx barroti</i>	II								
	<i>Lamporhynchus calolaema</i>	V	II	N3						
	<i>Lepidopyga coeruleogularis</i>	V	II				X	X		
	<i>Microchera albocoronata</i>		II	N3				X		
	<i>Phaethornis guy</i>		II				X		X	
	<i>Phaethornis longuemareus</i>		II				X	X	X	
	<i>Phaethornis superciliosus</i>		II				X	X	X	
	<i>Thalurania colombica</i>		II				X	X	X	
	<i>Threnetes ruckeri</i>	II					X	X	X	

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
Charadriiformes										
	Scolopacidae									
	<i>Actitis macularia</i>					t,r			x	
Ciconiiformes										
	Ardeidae									
	<i>Agamia agami</i>				N3		x		x	
	<i>Ardea alba</i>			III				x	x	x
	<i>Ardea herodias</i>					r			x	
	<i>Bubulcus ibis</i>			III				x	x	x
	<i>Butorides virescens</i>					r(p)			x	
	<i>Egretta caerulea</i>					r			x	x
	Cathartidae									
	<i>Cathartes aura</i>			II		t,r(p)		x	x	x
	<i>Coragyps atratus</i>			II				x	x	x
	<i>Sarcoramphus papa</i>	V		II,III					x	
Columbiformes										
	Bucconidae									
	<i>Nonnula ruficapilla</i>				N3		x	x	x	
	<i>Notharchus pectoralis</i>				N3		x	x	x	
	Columbidae									
	<i>Columba cayennensis</i>	x							x	
	<i>Columba fasciata</i>				N3				x	
	<i>Columba livia</i>			III					x	
	<i>Columba nigrirostris</i>	x						x	x	x
	<i>Columba speciosa</i>	x						x	x	
	<i>Columba subvinacea</i>	x	V					x	x	
	<i>Geotrygon chiriquensis</i>	x	V		N3			x	x	
	<i>Geotrygon lawrencii</i>	x	V		N3		r		x	
	<i>Geotrygon veraguensis</i>						r		x	

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Columbiformes									
	Galbulidae									
	<i>Jacamerops aurea</i>				N3			x		
	Ramphastidae									
	<i>Capito maculicoronatus</i>		V					x	x	x
	<i>Eubucco bourcierii</i>				N3			x		
	<i>Selenedeira spectabilis</i>				N3			x	x	
	<i>Buteo magnirostris</i>			II				x	x	
	<i>Buteo platypterus</i>			II		t,r		x		
	<i>Elanoides forficatus</i>			II		t(p)		x	x	x
	<i>Elanus leucurus</i>			II				x		
	<i>Gampsonyx swaisonii</i>			II	N2			x		
	<i>Harpagus bidentatus</i>			II				x		x
	<i>Harpagus bidentatus</i>			II						x
	<i>Ictinia plumbea</i>			II		i		x	x	x
	<i>Leucopternis plumbea</i>		V	II	N2		x	x	x	
	<i>Leucopternis semiplumbea</i>		V	II	N3			x	x	
	<i>Pandion halieatus</i>			II				x		
	<i>Spizaetus tyrannus</i>			II				x	x	
	Falconiformes									
	Falconidae									
	<i>Micrastur ruficollis</i>				II			x	x	x
	<i>Milvago chimachima</i>				II			x	x	x
	Galliformes									
	Cracidae									
	<i>Crax rubra</i>	x	V	III	N2			x		
	<i>Chamaepetes unicolor</i>	x	V		N2			x	x	
	<i>Ortalis cinereiceps</i>	x			N3			x		x
	<i>Penelope purpurascens</i>	x	V	III	N3			x		

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Galliformes									
	<i>Eurypygidae</i>									
	<i>Eurypyga helias</i>				N3		x		x	
	Odontophoridae									
	<i>Odontophorus gujanensis</i>	x	V		N3				x	
	<i>Odontophorus leucolaemus</i>		V		N2				x	
	Passeriformes									
	<i>Cotingidae</i>									
	<i>Querula purpurata</i>			II				x	x	x
	<i>Dendrocolaptidae</i>									
	<i>Deconychura longicauda</i>				N3			x	x	x
	<i>Sporophila schistacea</i>				N3		x	x		
	<i>Formicariidae</i>									
	<i>Grallaria guatimalensis</i>				N2		x		x	
	<i>Pittasoma michleri</i>				N3		x		x	
	<i>Furnariidae</i>									
	<i>Hyloctistes subulatus</i>				N2		x		x	
	<i>Margarornis rubiginosus</i>		V		N3				x	
	<i>Pseudocolaptes lawrencii</i>				N3				x	
	<i>Sclerurus mexicanus</i>				N3		x		x	
	<i>Syndactyla subalaris</i>				N3				x	
	<i>Xenops rutilans</i>				N3		x		x	
	<i>Hirundinidae</i>									
	<i>Hirundo rustica</i>					t		x	x	
	<i>Tachycineta albilinea</i>				N3			x		
	<i>Icteridae</i>									
	<i>Icterus galbula</i>					r		x	x	
	<i>Icterus spurius</i>					r				x

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Passeriformes									
	Parulidae									
	<i>Basileuterus tristriatus</i>				N3				x	
	<i>Dendroica castanea</i>					t,r			x	x
	<i>Dendroica fusca</i>					t,r				x
	<i>Dendroica coeruleascens</i>					r	x		x	
	<i>Dendroica magnolia</i>					r			x	
	<i>Dendroica pensylvanica</i>					r		x	x	x
	<i>Dendroica petechia</i>					t,r		x	x	x
	<i>Geothlypis trichas</i>					r	x		x	x
	<i>Mniotilla varia</i>					t,r			x	x
	<i>Myioborus torquatus</i>	V		N3					x	
	<i>Oporornis agilis</i>					t	x	x		
	<i>Oporornis formosus</i>					r		x		x
	<i>Oporornis philadelphia</i>					t,r		x	x	x
	<i>Zeledonia coronata</i>	V					x		x	
	<i>Vermivora chrysoptera</i>					t			x	
	<i>Vermivora peregrina</i>					t,r		x		x
	<i>Seiurus motacilla</i>					t,r			x	x
	<i>Seiurus novaboracensis</i>					t,r		x	x	x
	<i>Protonotaria citrea</i>					t,r		x		x
	<i>Wilsonia citrina</i>					r	x	x		
	Pipridae									
	<i>Corapipo altera</i>				N3				x	x
	Rhinocryptidae									
	<i>Scytalopus argentifrons</i>	V		N2					x	
	Sylviidae									
	<i>Microbates cinereiventris</i>				N3			x	x	x

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Passeriformes									
	Turdidae									
	<i>Catharus fuscater</i>				N3			x		
	<i>Catharus ustulatus</i>					t,r		x		x
	<i>Myadestes melanops</i>	V			N3					
	<i>Turdus obsoletus</i>				N3			x	x	
	Thamnophilidae									
	<i>Cercomacra nigricans</i>				N3			x	x	x
	<i>Gymnocichla nudiceps</i>				N3			x	x	
	<i>Myrmeciza immaculata</i>				N3			x	x	
	<i>Myrmeciza laemosticta</i>				N3				x	
	Thraupidae									
	<i>Bangsia arcaei</i>		V		G3		x		x	
	<i>Chlorospingus flavigularis</i>		V				x		x	
	<i>Dacnis venusta</i>				N3			x	x	
	<i>Euphonia anneae</i>	V						x	x	
	<i>Heterospingus rubrifrons</i>	V						x		
	<i>Piranga olivacea</i>					t,r			x	
	<i>Piranga rubra</i>					t,r			x	x
	<i>Tangara dowii</i>		V		N3		x		x	
	Troglodytidae									
	<i>Thryothorus thoracicus</i>				N3			x		
	Tyrannidae									
	<i>Contopus cooperi</i>					t,r			x	
	<i>Contopus virens</i>					t		x	x	x
	<i>Empidonax flaviventris</i>					r		x		
	<i>Empidonax traillii</i>					t,r				x
	<i>Empidonax virescens</i>					t,r		x	x	x
	<i>Legatus leucophaius</i>					i			x	

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Tyrannidae									
	<i>Leptopogon amaurocephalus</i>		V		N3		x		x	
	<i>Myiarchus crinitus</i>					r			x	x
	<i>Myiobius barbatus</i>				N3				x	
	<i>Myiodynastes hemichrysus</i>		V		N3				x	
	<i>Oncostoma olivaceum</i>		V					x	x	x
	<i>Pachyramphus polychopterus</i>				N2		x			x
	<i>Vireo flavifrons</i>					t,r				x
	<i>Vireo flavoviridis</i>					i			x	x
	<i>Vireo olivaceus</i>					t		x	x	x
	Psittaciformes									
	Psittacidae									
	<i>Amazona autumnalis</i>				II			x	x	x
	<i>Amazona farinosa</i>				II				x	
	<i>Amazona ochrocephala</i>	x	V	II	N3			x		x
	<i>Brotogeris jugularis</i>				II			x	x	x
	<i>Pionopsitta hematotis</i>				II				x	
	Psittacidae									
	<i>Pionus menstruus</i>				II			x	x	x
	Strigiformes									
	Strigidae									
	<i>Ciccaba virgata</i>				II			x	x	x
	<i>Lophostrix cristata</i>				II				x	
	<i>Otus choliba</i>				II			x		x
	<i>Otus guatemalae</i>				II				x	
	Tinamiformes									
	Tinamidae									
	<i>Crypturellus soui</i>	x						x	x	x
	<i>Tinamus major</i>	x						x	x	x

Table No. 6
Species of Birds of Special Interest in Three Basins
of the Western Región Watershed of the Canal of Panamá

Order	Family/Specie	LP	UICN National	CITES	TNC National	Migratory	Rare	Caño Sucio	Toabré	Indio
	Trononiformes									
	Trogonidae									
	<i>Trogon clathratus</i>		V				X		X	

V: Vulnerable

LP: Panamenian Laws

CITES: Appendices of the Convention on the International Commerce of Species Threatened of Flora and Fauna.

TNC National: Species protected inside the country.

UICN National: Species protected inside the country.

N2, N3: Specie with Habitat of restricted distribution

t: Transitory species

r: Resident winter species

p: Migratory partial

i: Migratory Intertropical

Fuente: Louis Berger, 2003.

Table No.7
Species of Mammals Reported in three Sub-Basins of the Western Watershed of the Canal of Panama.

ORDER	FAMILY	specie	CS	TB	IN
DIDELPHIMORPHIA	DIDELPHIDAE	<i>Didelphis maursupialis</i>	PC	PC	PC
		<i>Philander opossum</i>		R	
		<i>Chironectes minimus</i>		R	
		<i>Marmosa sp</i>		R	
XENARTHRA	MYRMECOPHAGIDAE	<i>Tamandua mexicana</i>			R
	BRADYPODIDAE	<i>Bradypus variegatus</i>			PC
	DASYPODIDAE	<i>Dasyprocta novemcinctus</i>	PC	C	C
CHIROPTERA	EMBALLONURIDAE	<i>Rhynchonycteris naso</i>		R	
	MORMOOPIDAE	<i>Pteronotus parnellii</i>	R	R	PC
	NOCTILIONIDAE	<i>Noctilio albiventris</i>	R		
	PHYLLOSTOMIDAE	<i>Artibeus hartii</i>		R	R
		<i>Artibeus intermedius</i>	R		R
		<i>Artibeus jamaicensis</i>	C,R,A		A,C,PC
		<i>Artibeus lituratus</i>	PC,R		PC
		<i>Artibeus phaeotis</i>	PC,R		PC
		<i>Artibeus watsoni</i>			R
		<i>Carollia brevicauda</i>		PC	R
		<i>Carollia castanea</i>	PC,R		PC,R
		<i>Carollia perspicillata</i>	A		PC,C
		<i>Chiroderma salvini</i>			R
		<i>Chiroderma villosum</i>	R		
		<i>Desmodus rotundus</i>		PC	C
		<i>Glossophaga commissarisi</i>	R,PC		PC,R
		<i>Glossophaga soricina</i>			R
		<i>Lonchophylla robusta</i>		PC	R
		<i>Phyllostomus discolor</i>		PC	R
		<i>Phyllostomus hastatus</i>		R	R
		<i>Phyllostomus stenops</i>			R
		<i>Platyrrhinus helleri</i>	PC,R	C	PC,R
		<i>Platyrrhinus vittatus</i>			
		<i>Sturnira lilium</i>	R	R	PC,R
		<i>Tonatia brasiliense</i>		R	R
		<i>Tonatia saurophila</i>	R	R	
		<i>Tonatia silvicola</i>		R	R
		<i>Uroderma bilobatum</i>	R		R
		<i>Vampyressa nymphaea</i>		R	
		<i>Vampyressa pusilla</i>		PC	R
		<i>Vampyrodes caraccioli</i>		R	
	MOLOSSIDAE	<i>Promops centralis</i>			R
	VESPERTILIONIDAE	<i>Myotis nigricans</i>	R		
		<i>Myotis sp.</i>	R		
PRIMATES	CALLITRICHIDAE	<i>Saguinus geoffroyi</i>	PC	PC	PC
	CEBIDAE	<i>Aotus lemurinus</i>			PC
		<i>Cebus capucinus</i>		PC	
		<i>Alouatta palliata</i>		PC	
RODENTIA	SCIURIDAE	<i>Sciurus variegatoides</i>	PC	PC	C
		<i>Sciurus granatensis</i>	PC	C	C
		<i>Microsciurus mimulus</i>			R

ORDER	FAMILY	Species	CS	TB	IN
RODENTIA	HETEROMYDAE	<i>Heteromys desmarestianus</i>		PC	PC
	HYDROCHAERIDAE	<i>Hydrochaeris hydrochaeris</i>	R		R
	ECHYIMIDAE	<i>Proechymis semispinosus</i>	PC		
	MURIDAE	<i>Oryzomys alfaroi</i>			R
		<i>Melanomys caliginosus</i>			R
		<i>Rattus rattus</i>			R
	ERETHIZONTIDAE	<i>Coendou rothschildi</i>		R	R
	AGOUTIDAE	<i>Agouti paca</i>	R	PC, R	PC
	DASYPROCTIDAE	<i>Dasyprocta punctata</i>	R	R, C	PC
	ECHYIMIDAE	<i>Proechymis semispinosus</i>		C	C
LAGOMORPHA	LEPORIDAE	<i>Sylvilagus brasiliensis</i>		PC	
CARNIVORA					
	PROCYONIDAE	<i>Procyon lotor</i>		R	R
		<i>Nasua narica</i>	PC	PC	
		<i>Potos flavus</i>		PC	
	MUSTELIDAE	<i>Conepatus semistriatus</i>		R	R
		<i>Lontra longicaudis</i>	R		R
	FELIDAE	<i>Puma concolor</i>			R
		<i>Leopardus pardalis</i>		PC	PC
		<i>Leopardus wiedii</i>			
		<i>Herpailurus yaguarondi</i>		R	
		<i>Panthera onca</i>		R	
PERISSODACTYLA	TAPIRIDAE	<i>Tapirus bairdii</i>		R	
ARTIODACTYLA	TAYASSUIDAE	<i>Tayassu tajacu</i>		PC	PC
	CERVIDAE	<i>Odocoileus virginianus</i>	R	PC	R
		<i>Mazama americana</i>	R	PC, R	

Source: Louis Berger, 2003.

R: Rare

PC: Slightly common

C: Common

A: Abundant

CS: Caño Sucio

TB: Toabré

IN: Indio

Table No. 8

ORDER	FAMILY	S+C55SPECIE	Caño Sucio	Toabré	Indio	EPL	CITES 1	CITES 2	EP	ISP	V	R	END
CHIROPTERA	VESPERTILIONIDAE												
		<i>Myotis nigricans</i>	x									x	
PRIMATES	CEBIDAE	<i>Myotis sp.</i>	x									x	
		<i>Alouatta palliata</i>		x									
RODENTIA	CALLITRICHIDAE	<i>Aotus lemurinus</i>		x	x	x		x	x	x**			
		<i>Cebus capucinus</i>		x		x		x			x		
CARNIVORA	SAGINUS GEOFFROYI	<i>Saguinus geoffroyi</i>	x	x	x	x	x		x	x**			
		<i>Coendou rothschildi</i>			x						x	x	
	HYDROCHAERIDAE	<i>Hydrochaeris hydrochaeris</i>	x						x				
		<i>Agouti paca</i>	x	x	x	x				x			
	DASYPROCTIDAE	<i>Dasyprocta punctata</i>	x	x	x	x					x		
		<i>Proechymis semispinosus</i>	x										
	ECHYIMIDAE												
PERYSSODACTyla	PROCYONIDAE	<i>Bassaricyon gabbi</i>		x							x		
		<i>Nasua narica</i>	x		x						x		
		<i>Potos flavus</i>		x							x		
		<i>Procyon lotor</i>		x	x	x					x		
	FELIDAE	<i>Leopardus pardalis</i>	x	x	x	x	x		x				
		<i>Panthera onca</i>		x		x	x			x			
		<i>Puma concolor</i>		x		x	x			x			
ARTIODACTYLa	MUSTELIDAE	<i>Conepatus semistriatus</i>			x						x		
		<i>Lutra longicaudis</i>	x		x		x		x				
	TAPIRIDAE	<i>Tapirus bairdii</i>		x		x	x		x				
		<i>Tayassu tajacu</i>			x						x		

ORDER	FAMILY	S+C55SPECIE	Caño Sucio	Toabré	Indio	EPL	CITES 1	CITES 2	EP	ISP	V	R	END
ARTIODACTYLA	CERVIDAE												
		<i>Odocoileus virginianus</i>	x		x						x		
		<i>Mazama americana</i>	x			x					x		

* Inn-keeper of the illness of chagas

** Inn-keeper of the illness of Leishmaniasis

*** Bat hematophagus

EPL: Protected species by panamenian laws

CITES 1 y 2: Species listed in International conventions

EP: Endangered

ISP: Of importance to the public health

V: Vulnerable

R: Rare

END: Endemic

Source: Louis Berger, 2003.

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Acanthaceae	<i>Blechum pyramidatum</i>											x	x
	<i>Justicia comata</i>											x	x
	<i>Odontonema tubaeforme</i>												x
Amaranthaceae	<i>Cyathula achyranthoides</i>											x	
Amaryllidaceae	<i>Pancratium littorale</i>												x
Anacardiaceae	<i>Anacardium excelsum</i>											x	
	<i>Anacardium occidentale</i>											x	
	<i>Mangifera indica</i>											x	
	<i>Mosquitoxylum jamaicense</i>											x	
	<i>Spondias mombin</i>	Clavellín										x	
	<i>Spondias purpurea</i>												x
	<i>Spondias radlkoferi</i>												x
	<i>Tapirira guianensis</i>												x
Annonaceae	<i>Annona montana</i>	Guanábana de montaña								x		x	
	<i>Annona spraguei</i>		x							x		x	
	<i>Guatteria amplifolia</i>									x			
	<i>Guatteria crispiflora</i>	Negrito1								x			
	<i>Xylopia frutescens</i>									x		x	
Apocynaceae	<i>Aspidosperma spruceanum</i>	Alcarreto colorado								x	x	x	
	<i>Couma macrocarpa</i>	Pera de montaña								x	x	x	
	<i>Himatanthus articulatus</i>	Calacuche								x			
	<i>Mandevilla hirsuta</i>									x	x		
	<i>Mandevilla villosa</i>									x	x		
	<i>Plumeria pudica</i>									x			
	<i>Stemmadenia alfsari</i>	Suspiro								x			
	<i>Stemmadenia macrophylla</i>											x	
Aquifoliaceae	<i>Ilex stellata</i>										x		
	<i>Ilex yurumanguinis</i>											x	

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Araceae	<i>Anthurium clavigerum</i>										x		
	<i>Anthurium friedrichsthalii</i>											x	
	<i>Anthurium lancifolium</i>											x	
	<i>Anthurium pentaphyllum</i>										x		
	<i>Anthurium scandens</i>		x									x	
	<i>Anthurium spathiphyllum</i>										x		
	<i>Anthurium trinerve</i>										x		
	<i>Anthurium trisectum</i>										x		
	<i>Anthurium trisectum</i>										x		
	<i>Colocasia esculenta</i>											x	
	<i>Dracontium sp.</i>										x		
	<i>Homalomena wendlandii</i>										x		
	<i>Philodendron inaequilaterum</i>										x		
	<i>Philodendron radiatum</i>										x		
	<i>Syngonium schottianum</i>												
Araliaceae	<i>Dendropanax arboreus</i>	Harino blanco1								x	x	x	
	<i>Dendropanax latilobus</i>	Harino blanco									x		
	<i>Sciadodendron excelsum</i>										x		
Arecaceae	<i>Asterogyne martiana</i>										x		
	<i>Astrocaryum standleyanum</i>										x		
	<i>Attalea allenii</i>										x		
	<i>Attalea butyracea</i>									x	x		
	<i>Bactris hondurensis</i>										x		
	<i>Chamaedorea pinnatifrons</i>										x		
	<i>Euterpe precatoria</i>	Palmito									x		
	<i>Geonoma cuneata</i>		x								x		
	<i>Geonoma epetiolata</i>										x		
	<i>Iriartea deltoidea</i>	Palmito1										x	
	<i>Oenocarpus batatua</i>		x								x		
	<i>Socratea exorrhiza</i>	Palma jira	x							x		x	
	<i>Welfia regia</i>	Palma conga									x	x	
Asclepiadaceae	<i>Asclepias curassavica</i>										x	x	

Table No 9

Table No 9
List of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Blechnaceae	<i>Blechnum occidentale</i>											x	
	<i>Salpichlaena volubilis</i>										x	x	x
Bombacaceae	<i>Ceiba pentandra</i>											x	x
	<i>Matisia exalata</i>	Cacaillo		x	x							x	
	<i>Pachira aquatica</i>											x	
Boraginaceae	<i>Cordia alliodora</i>											x	
	<i>Cordia lucidula</i>	Laurel negro								x		x	
	<i>Cordia spinescens</i>										x	x	
	<i>Heliotropium curassavicum</i>										x		
Bromeliaceae	<i>Aechmea magdalena</i>												x
	<i>Guzmania calamifolia</i>		x								x		
	<i>Guzmania musaica</i>		x								x		
	<i>Ronnbergia explodens</i>		x								x		
	<i>Tillandsia punctulata</i>											x	
Burseraceae	<i>Protium pittieri</i>				x							x	
	<i>Trattinnickia aspera</i>	Caraño								x		x	
Calymperaceae	<i>Syrrhopodon isthmi</i>		x								x		
Caricaceae	<i>Jacaratia costaricensis</i>											x	
Caryophyllaceae	<i>Drymaria cordata</i>										x		
Cecropiaceae	<i>Cecropia peltata</i>											x	
Celastraceae	<i>Quetzalia occidentalis</i>										x		
	<i>Zinowiewia costaricensis</i>							x			x		
Chloranthaceae	<i>Hedyosmum bonplandianum</i>	Palo de agua									x		

Table No 9
List of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Chrysobalanaceae	<i>Hirtella latifolia</i>	Camaroncillo									x	x	
	<i>Hirtella triandra</i>										x		
	<i>Licania arborea</i>	Rasca									x		
	<i>Licania jefensis</i>	Raspo										x	
	<i>Maranthes sp.</i>											x	
Clethraceae	<i>Clethra coloradensis</i>										x		
	<i>Clethra lanata</i>										x		
Clusiaceae	<i>Calophyllum longifolium</i>	María	x								x		
	<i>Calophyllum nubicola</i>	María			x						x		
	<i>Chrysochlamys grandifolia</i>	grandifolia									x		
	<i>Chrysochlamys psychotriifolia</i>									x			
	<i>Clusia minor</i>										x		
	<i>Clusia uvitana</i>											x	
	<i>Dystomovita paniculata</i>										x		
	<i>Garcinia intermedia</i>	Cerillo					x				x		
	<i>Garcinia madruno</i>						x					x	
	<i>Marila laxiflora</i>									x	x	x	
	<i>Sympodia globulifera</i>	Cerillo	x							x	x	x	
	<i>Tovomita weddelliana</i>										x		
	<i>Tovomita longifolia</i>	Copé								x	x	x	
	<i>Tovomita stylosa</i>											x	
	<i>Tovomitopsis myrcioides</i>										x		
	<i>Vismia baccifera</i>	Pinta mozo									x	x	
	<i>Vismia billbergiana</i>											x	
	<i>Vismia jefensis</i>			x									
	<i>Vismia macrophylla</i>											x	
Combretaceae	<i>Terminalia amazonica</i>		x							x	x	x	
Commelinaceae	<i>Floscopa robusta</i>											x	
	<i>Tripogandra serrulata</i>										x	x	

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Connaraceae													
	<i>Cnestidium rufescens</i>											x	
Convolvulaceae	<i>Maripa panamensis</i>											x	
Costaceae	<i>Costus laevis</i>											x	
	<i>Costus villosissimus</i>										x	x	
	<i>Dimerocostus strobilaceus</i>											x	
Cucurbitaceae	<i>Cayaponia glandulosa</i>											x	
	<i>Cayaponia granatensis</i>											x	
	<i>Cayaponia racemosa</i>											x	
	<i>Gurania tubulosa</i>											x	
	<i>Momordica charantia</i>										x		
	<i>Rytidostylis carthaginensis</i>										x	x	
Cyatheaceae	<i>Alsophila cuspidata</i>										x		
	<i>Cyathea delgadii</i>				x						x		
	<i>Cyathea petiolata</i>		x		x				x		x		
	<i>Cyathea schiedeana</i>											x	
Cyclanthaceae	<i>Carludovica drudei</i>										x	x	
	<i>Carludovica palmata</i>		x									x	
	<i>Cyclanthus bipartitus</i>		x							x	x	x	
Cyperaceae	<i>Cyperus laxus</i>										x	x	
	<i>Cyperus luzulae</i>										x	x	
	<i>Cyperus tenuis</i>										x	x	
	<i>Fimbristylis dichotoma</i>											x	
	<i>Fimbristylis littoralis</i>										x		
	<i>Kyllinga pumila</i>										x		
	<i>Mapania assimilis</i>									x			
	<i>Rhynchospora argentea</i>										x		
	<i>Rhynchospora cephalotes</i>											x	
	<i>Rhynchospora nervosa</i>										x		

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Cyperaceae	<i>Rhynchospora nervosa</i>											x	
	<i>Scleria melaleuca</i>											x	x
	<i>Scleria microcarpa</i>											x	
	<i>Torulinium odoratum</i>											x	x
Cyrillaceae	<i>Cyrilla racemiflora</i>											x	
Davalliaceae	<i>Nephrolepis exaltata</i>											x	
	<i>Nephrolepis pendula</i>											x	
Dennstaedtiaceae	<i>Hypolepis repens</i>											x	
	<i>Pteridium caudatum</i>											x	
Dilleniaceae	<i>Doliocarpus major</i>											x	
Dioscoreaceae	<i>Dioscorea standleyi</i>						x					x	
Dryopteridaceae	<i>Polybotrya caudata</i>									x		x	
Elaeocarpaceae	<i>Sloanea stipitata</i>	Carretillo										x	
Ericaceae	<i>Disterigma trimerum</i>											x	
Erythroxylaceae	<i>Erythroxylum macrophyllum</i>											x	x
Euphorbiaceae	<i>Acalypha diversifolia</i>											x	x
	<i>Acalypha macrostachya</i>											x	
	<i>Alchornea latifolia</i>	Cacao de montaña								x		x	
	<i>Croton billbergianus</i>									x		x	
	<i>Croton trinitatis</i>									x		x	
	<i>Hura crepitans</i>									x			
	<i>Hieronima alchorneoides</i>	Vaquerillo								x	x	x	
	<i>Hieronima oblonga</i>	Guabo rosario									x		
	<i>Mabea occidentalis</i>	Cauchillo								x	x	x	

Table No 9

list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

Table No 9

Table No 9

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Malvaceae	<i>Hampea albipetala</i>											x	
	<i>Hampea micrantha</i>				x							x	
	<i>Malvaviscus arboreus</i>		x									x	
	<i>Pavonia fruticosa</i>											x	
	<i>Sida acuta</i>											x	
	<i>Sida rhombifolia</i>											x	x
	<i>Urena lobata</i>											x	
	<i>Wercklea ferox</i>											x	
Marantaceae	<i>Calathea allenii</i>											x	
	<i>Calathea insignis</i>											x	x
	<i>Calathea lasiostachya</i>											x	
	<i>Calathea marantifolia</i>											x	
	<i>Calathea micans</i>											x	x
	<i>Calathea nodosa</i>											x	
	<i>Ischnosiphon aromatica</i>											x	
	<i>Stromanthe jacquinii</i>											x	
Marattiaceae	<i>Danaea elliptica</i>											x	
Melastomataceae	<i>Aciotis caulialata</i>											x	
	<i>Aciotis indecora</i>											x	x
	<i>Bellucia pentamera</i>											x	
	<i>Clidemia capitellata</i>											x	x
	<i>Clidemia coloradensis</i>										x		
	<i>Clidemia dentata</i>										x	x	
	<i>Clidemia discolor</i>										x	x	
	<i>Clidemia epiphytica</i>											x	
	<i>Clidemia hirta</i>										x		
	<i>Clidemia lanuginosa</i>										x		
	<i>Clidemia quinquenervia</i>										x		
	<i>Conostegia setosa</i>		x								x		
	<i>Conostegia subcrustulata</i>											x	
	<i>Ossaea laxivenula</i>		x								x		

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Melastomataceae	<i>Leandra chaetodon</i>									x			
	<i>Leandra granatensis</i>										x	x	
	<i>Leandra mexicana</i>											x	
	<i>Miconia affinis</i>	Titicillo colorado								x		x	
	<i>Miconia argentea</i>										x	x	
	<i>Miconia barbinervis</i>										x	x	
	<i>Miconia curvipetiolata</i>										x		
	<i>Miconia gracilis</i>											x	
	<i>Miconia ligulata</i>										x		
	<i>Miconia oinochrophylla</i>										x		
	<i>Miconia serrulata</i>											x	
	<i>Miconia smaragdina</i>											x	
	<i>Miconia valeriana</i>		x								x		
	<i>Tribouchina wurdackii</i>										x		
Meliaceae													
	<i>Carapa guianensis</i>	Bateo								x	x	x	
	<i>Cedrela odorata</i>			x							x		
	<i>Guarea glabra</i>	Pica lengua								x	x	x	
	<i>Guarea grandifolia</i>										x		
	<i>Guarea guidonia</i>												x
	<i>Guarea rhophalocarpa</i>									x			
	<i>Trichilia glabra</i>	Cocá1									x		
Menispermaceae	<i>Trichilia martiana</i>	Cocá2									x		
	<i>Cissampelos pareira</i>										x		
Metaxyaceae													
	<i>Metaxya rostrata</i>										x		
Monimiaceae													
	<i>Siparuna cuspidata</i>	Pasmo de montaña								x	x	x	
	<i>Siparuna gesnerioides</i>											x	
	<i>Siparuna guianensis</i>		x									x	
Moraceae	<i>Siparuna pauciflora</i>	Pasmo	x								x	x	
	<i>Brosimum alicastrum</i>	Berbá								x	x	x	
	<i>Brosimum guianensis</i>	Cacique									x		

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Moraceae	<i>Brosimum rubescens</i>	Cocobolo									x	x	x
	<i>Castilla elastica</i>											x	x
	<i>Castilla tunu</i>												x
	<i>Ficus insipida</i>											x	x
	<i>Maquira guianensis</i>		x										x
	<i>Naucleopsis ulei</i>	Cocá verde								x		x	
	<i>Perebea xanthochyma</i>											x	x
	<i>Poulsenia amata</i>											x	
	<i>Trophis caucana</i>												x
Myristicaceae	<i>Compsoneura sprucei</i>									x			
	<i>Otoba novogranatensis</i>		x									x	
	<i>Virola sebifera</i>	Miguelario colorado										x	
	<i>Virola surinamensis</i>		x									x	x
Myrsinaceae	<i>Ardisia opegrapha</i>												x
	<i>Parathesis amplifolia</i>	Saginillo	x	x								x	
Myrtaceae	<i>Psidium guajava</i>											x	x
	<i>Psidium guineense</i>											x	
	<i>Syzygium jambos</i>											x	x
	<i>Syzygium malaccense</i>											x	
Nyctaginaceae	<i>Guapira costaricana</i>											x	
	<i>Neea amplifolia</i>											x	
Ochnaceae	<i>Cespdezia macrophylla</i>	Membrillo de montaña									x		
	<i>Ouratea lucens</i>										x		
	<i>Sauvagesia erecta</i>										x	x	
Olacaceae	<i>Heisteria cyanocarpa</i>		x									x	
	<i>Chiariantus domingensis</i>											x	
	<i>Minquartia guianensis</i>	Almendro					x			x	x	x	
Onagraceae	<i>Ludwigia affinis</i>										x	x	

Table No 9

Table No 9
List of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

Table No 9

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Rubiaceae	<i>Psychotria graciliflora</i>												x
	<i>Psychotria guapilensis</i>												x
	<i>Psychotria horizontalis</i>											x	
	<i>Psychotria luxurians</i>											x	
	<i>Psychotria macrophylla</i>											x	
	<i>Psychotria marginata</i>										x	x	
	<i>Psychotria microbotrys</i>									x			
	<i>Psychotria officinalis</i>										x		
	<i>Psychotria poeppigiana</i>									x	x	x	
	<i>Psychotria psychotriifolia</i>										x		
	<i>Psychotria pubescens</i>									x	x		
	<i>Psychotria racemosa</i>									x	x		
	<i>Psychotria suerrensis</i>										x		
	<i>Psychotria tenuifolia</i>										x		
	<i>Raritebe palicoureoides</i>		x								x		
	<i>Rondeletia hammeliifolia</i>										x		
	<i>Rudgea cornifolia</i>										x		
	<i>Sabicea villosa</i>									x	x		
	<i>Simira maxonii</i>										x		
	<i>Spermacoce confusa</i>									x			
	<i>Warscewiczia coccinea</i>	Pico de loro								x	x		
Rutaceae	<i>Citrus sinensis</i>										x		
	<i>Hortia colombiana</i>	Aceituna	x							x		x	
	<i>Zanthoxylum acuminatum</i>										x		
	<i>Zanthoxylum melanostictum</i>	Jumo								x			
	<i>Zanthoxylum panamense</i>									x	x		
	<i>Zanthoxylum setulosum</i>									x			
Sapindaceae	<i>Allophylus gentry</i>			x							x		
	<i>Allophylus psilospermus</i>	Cuamo								x			
	<i>Cupania cinerea</i>									x		x	
	<i>Cupania rufescens</i>									x			
	<i>Cupania scrobiculata</i>									x			
	<i>Sapindus caudatum</i>	Olivo								x			

ANNEX 4-A

Total of Hectares by Type of Vegetation Cover.
HECTARES

LEGEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL
Mature Forest	10,146.9	7,699.4	2787.7	1310.95	2,392.4	952.7	15,109.6	26,209.3
Pasture Landl	5,725.2	2,816.9	1314.6	267.06	334.3	5,485.8	18,787.6	29,998.6
Stubble	22,788.3	15,722.9	5300.4	1985.09	3,359.4	5,400.4	38,966.2	67,154.9
TOTAL	38,660.5	26,239.2	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.8

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE RESERVOIRS

LEYEND	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
	80-40	45-40	50-40	45-40	155	130				100-90	100-90
Mature Forest	403.7	142.8	101.9	97.0	81.65	34.66	337.3	3.4	89.8	45.2	29.4
Pasture Land	1,561.6	800.9	218.0	198.2	440.4	299.3	55.1	5.4	743.2	1504.8	966.4
Stubble	2,573.2	1,150.2	531.8	489.0	854.3	426.0	432.2	102.1	521.5	3385.3	2429.4
TOTAL	4,538.6	2,094.0	851.7	784.2	1,376.3	760.0	824.5	110.8	1,354.5	4,935.3	3,425.1

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

LEYEND	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		CANTERAS Y PRESTAMOS	
	80-40	45-40	50-40	45-40	155	130				100-90	100-90	95-50	
Mature Forest	11.7	11.7	11.7	11.7	0.0	0.0	4.0	5.0	3.6	5.205	5.205	150.0	
Pasture Land	46.1	46.1	46.1	46.1	7.3	7.3	12.3	13.7	49.7	25.019	25.019	368.9	
Stubble	51.3	51.3	51.3	51.3	1.9	1.9	27.9	46.3	31.8	49.374	49.374	321.4	
TOTAL	109.2	109.2	109.2	109.2	9.2	9.2	44.2	64.9	85.1	79.6	79.6	840.4	

HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
MATURE FOREST	565.5	304.6	263.7	258.8	658.9	398.0	600.0	339.2	709.3	448.4	573.01	534.36
PASTURE LAND	1976.7	1216.0	633.1	613.2	2769.6	2008.9	2968.1	2207.4	4299.4	3538.7	883.93	761.89
STUBLE	2946.0	1523.0	904.5	861.7	3499.3	2076.2	5424.7	4001.7	6933.9	5510.9	1637.75	1357.89
TOTAL	5488.1	3043.5	1,801.3	1,733.8	6,927.7	4,483.1	8,992.8	6,548.2	11,942.7	9,498.0	3,094.7	2,654.1

Total of Hectares by Type of Metallic authorizations And No Metallic authorizations
HECTARES

LEYEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL
Metallic authorizations	38,100.2	26,009.3	5907.8	3621.12	5,824.7	11838.910	72864.730	122,803.8
Without Information	560.5	230.0	0.0	0.00	227.6	0.0	0.0	560.5
No Metallic authorizations	0.0	0.0	0.0	0.00	0.0	0.0	0.0	
TOTAL	38,660.7	26,239.2	5,907.8	3621.12	6,052.3	11,838.9	72864.730	123,364.3

TOTAL OF HECTARES POTENCIALLY AFECTED BY THE RESERVOIRS

LEYEND	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
	80-40	45-40	50-40	45-40	155	130				100-90	100-90
Metallic authorizations	4,478.9	2,081.0	851.7	784.2	1171.7	760.0	743.5	110.0	1,354.5	4117.5	3425.1
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Without Information	60.0	13.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	4,538.9	2,094.0	851.7	784.2	1,171.7	760.0	743.5	110.0	1,354.5	4,117.5	3,425.1

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

LEYEND	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		QUARRIES AND LOAND
	80-40	45-40	50-40	45-40	155	130				100-90	100-90	
Metallic authorizations	109.2	109.2	109.2	109.2	9.2	9.2	44.2	64.9	85.1	79.600	79.600	840.4
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	109.2	109.2	109.2	109.2	9.2	9.2	44.2	64.9	85.1	79.6	79.6	840.4

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Metallic authorizations	4,478.9	2,081.0	851.7	784.2	5,833.4	3,435.5	7,904.0	5,506.1	9,950.8	7,552.9	1,503.6	1,613.6
No Metallic authorizations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Without Information	60.0	13.0	0.0	0.0	60.0	13.0	60.0	13.0	60.0	13.0	0.0	0.0
TOTAL	4538.9	2094.0	851.7	784.2	5,893.4	3,448.5	7,964.0	5,519.1	10,010.8	7,565.9	1,503.6	1,613.6

CURRENT LAND USE

ALLUVIAL DEPOSITS

DESCRIPTION	HECTARES
Water	15.9860
Cow land	13.5230
Lowland dense Forest slowly Disturbed	
Disturbed Forest	6.8160
Stubble	48.1690
No Data	0.6070
TOTAL	85.1010

AREA OF BORROWING OF MATERIALS

DESCRIPTION	HECTARES
Water	0.179
Cow land	118.393
Lowland dense Forest slowly Disturbed	8.187
Disturbed Forest	118.129
Annual Crops	5.115
Stubble	204.323
No Data	240.620
TOTAL	694.9460

SANDY STONE QUARRY

DESCRIPTION	HECTARES
Cow land	30.083
Disturbed Forest	10.847
Annual Crops	2.769
Stubble	15.096
TOTAL	58.7950

CHANNEL INDIO CABECERA

DESCRIPTION	HECTARES
Cow land	1.4130
Lowland dense Forest slowly Disturbed	0.0260
Disturbed Forest	1.3840
Stubble	3.3050
TOTAL	6.1280

Total of Hectares for Description of Geology
HECTARES

Symbol	GROUP	FORMATION	FORMS	LEYEND	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL	
PI/PS-Cv		Cerro Viejo	Volcanics	Basalts/andesite, Glassy amigdaloids. Post-ignimbritesBasalts .	5,661.7	5,612.9	2,642.9	1,111.1			1,065.0	6,726.7	
QPS-P		C. Picacho	Volcanics	Basalts/andesite, conglomerates, alluvions, colluvions, Shale.	243.9	243.9	232.6					243.9	
QR-Aha	Aguadulce	Rio Halo	Sedimentary	Conglomerate, sandstone, Shale, tuffs, no consolidate sandstone, Pomice.	1,719.6	1,686.1	10.2		476.8		5,610.7	7,330.4	
TM-CATu	Cañazas	Tucué	Volcanics	Andesitas/basaltos, lavas, brechas, tobas y plugs.	23,729.3	16,321.3	5,845.5	1,783.2	5,105.6	9,042.5	52,086.3	84,858.2	
TM-Yen	La Yeguada	C. El Encanto	Volcanics	Dacites, riocacites, ignimbrites, sub-intrusives,tuffs and lavas.	991.2	981.8	671.52	668.9			12,012.0	13,003.2	
TMPL-VA		El Valle	Volcanics	Dacites, brech., plugs, fl. ignimbrit., pum., fine tuffs, Andesites/basalts, tuffs and fine grain sub-intrusives	528.2	528.2			503.6		413.4	941.6	
TO-CAI	Caimito	Caimito	Sedimentary	Tuffaceus sandstone, tuffaceus shale, tuffs, caliza foraminifer limestone. Quebrancha member-	5,786.2	865.7				2,796.4	1,507.4	10,090.0	
TPA-CHI	Chiguirí	Chiguirí	Sedimentary	Deformed shale							168.6	168.6	
					TOTAL	38,660.1	26,239.9	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.4

**TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE RESERVOIRS
GEOLOGICAL FORMATIONS**

SYMBOL	GROUP	FORMATION	FORMS	LEYEND	INDIO		ALTO INDIO		Terá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		
					80-40	45-40	50-40	45-40	155	130				100-90	100-90	
PI/PS-Cv		Cerro Viejo	Volcanics	Basalts/andesites,glassy amigdaloids. Post-ignimbrites Basalts.					253.326	60.70	520.47					
QPS-P		C. Picacho	Volcanics	Andesite/basalts, conglomerates, alluviums, colluvions, loddites.	6.0				205.05	140.26						
QR-Aha	Aguadulce	Rio Hato	Sedimentary	Conglomerate, Sandstone, Shale, Tuff, Unconsolidate Sandstone, Pumice.	810.4	348.6	364.5	326.2						94.6	38.3	
TM-CATu	Cañazas	Tucue	Volcanics	Basalts/sandesites, lavas, breccias, Tuffs and plugs.	753.7	218.8	238.1	218.8	917.9	559.0	66.1	110.8	1,146.1	3,986.0	2,602.4	
TM-Yen	La Yeguada	C. El Encanto	Volcanics	Dacitas, riocacites, ignimbrites , sub-intrusives, Tuffss and lavas.	121.8	3.4	5.3	3.4			237.96					
TMPL-VA		El Valle	Volcanics	Dacites, brech., plugs, fl. ignimbit., pum., to. finas. And./bas., tob. y s.intrusivos de gra. fino												
TO-CAI	Caimito	Caimito	Sedimentary	Tuffaceous sandstone, tuffaceous shale, shale, foraminife limestone. Quebrancha member - TOCALqr.	2,846.5	1,523.2	243.8	235.9						208.4	854.742	784.4
TPA-CHI	Chiguirí	Chiguirí	Sedimentary	Deformed shale												
					TOTAL	4,538.4	2,093.9	851.7	784.2	1,376.3	760.0	824.5	110.8	1,354.5	4,935.3	3,425.1

**TOTAL DE HECTAREAS POTENCIALMENTE AFECTADOS POR LAS OPCIONES
FORMACIONES GEOLOGICAS**

SIMBOLo	GRUPO	FORMACION	FORMAS	LEYENDA	Opción 1	Opción 2	Opción 3	Opción 4	Opción 5	Opción 6	Opción 7	Opción 8	Opción 9	Opción 10	Opción 11	Opción 12
PI/PS-Cv		Cerro Viejo	Volcánicas	Basaltos/andesita, amigdaloides vidriosos. Basaltos Post-ignimbriticos.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	773.79	581.17
QPS-P		C. Picacho	Volcánicas	Basaltos/andesita, conglomerados, aluviones, coluviones, lodoletas.	6.0	0.0	0.0	0.0	6.0	0.0	6.0	0.0	6.0	0.0	205.05	140.26
QR-Aha	Aguadulce	Rio Halo	Sedimentarias	Conglomerado, areniscas, lutitas, tobas, areniscas no consolidadas, poméz.	810.4	348.6	364.5	326.2	810.4	348.6	848.7	386.9	905.0	443.2	0.00	0.00
TM-CATu	Cañizas	Tucue	Volcánicas	Andesitas/basaltos, lavas, brechas, tobas y plugs.	753.7	218.8	238.1	218.8	1899.7	1364.9	3356.1	2821.2	5885.7	5350.9	984.06	735.99
TM-Yen	La Yeguada	C. El Encanto	Volcánicas	Dacitas, riocacitas, ignimbritas, sub-intrusivos, tobas y lavas.	121.8	3.4	5.3	3.4	121.8	3.4	121.8	3.4	121.8	3.4	237.96	237.96
TMPL-VA		El Valle	Volcánicas	Dacitas, brech., plugs, fl. ignimbrit., pum., to. finas. And./bas., tob. y s.intrusivos de gra. fino	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
TO-CAI	Caimito	Caimito	Sedimentarias	Arenisca lobácea, lutita lobácea, toba, caliza foraminifera. Miembro Quebrancha TOCALqr.	2846.5	1523.2	243.8	235.9	3054.9	1731.6	3630.8	2307.5	3909.7	2586.4	0.00	0.00
TPA-CHI	Chiguirí	Chiguirí	Sedimentarias	Lutitas deformadas.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
				TOTAL	4538.4	2093.9	851.7	784.2	5,892.9	3,448.5	7,963.5	5,519.1	10,828.2	8,383.8	2,200.9	1,695.4

Totals by Type of Infrastructure
HECTARES

INFRASTRUCTURE	RÍO INDIO	ALTO INDIO	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	31	27	3	3	3	1	75	107
Sewers							4	4
Recreative area, Football camps, Baseball parks, Parks.	22	20	6	2	2		36	58
Roads	62	48				5	250	317
Cemetery	33	25	6	3	2	5	67	105
Clinics or health post	9	6	2		1	2	13	24
Dining room, School Dining rooms	9	9	1	3	2			9
Commerce/Manufacturer/Agroindustrial	49	38	9	3	12	3	165	217
School	41	32	8	2	4	8	63	112
Electrical generation							4	4
Sustainable Farms	8	8	1	1	3		6	14
Governmental structure, Regidurias, Communal Houses, House of Local Government	26	22	5	2	3	3	42	71
Church or Chapel	52	42	12	3	4	8	84	144
Stop of Buses	1	1		1			20	21
Electrical posts	32	32			32		450	482
Pozo (subterranean Water reserve)							1	1
Permanent bridges, Pedestrian Bridge, Suspension bridge	24	12	2	1	3	9	87	120
Telecommunication, Telephonic Antenna , Public Phone	6	1	1				65	71
Electrical red, Post of light	1	1			1		133	134
TOTAL	406	324	56	24	72	44	1565	2015

TOTAL OF INFRASTRUCTURES AFFECTED BY THE RESERVOIR

	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
LEYEND	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	2				9		2			11	8
Sewers											
Recreational area, Football camps, Baseball parks, Parks.	6	4	2	2	10	3	2	1		7	5
Roads	15	8	6	6						5	5
Cemetery	8	4	3	3	11	1	1	1		8	4
Clinics or health post	3	1			3	2		1		2	2
Dining room, School Dining rooms					6		3	2			
Commerce/Manufacturer/Agroindustrial	16	7	1	1	24	4	3	1		7	6
School	11	3	1	1	14	4	2	1		8	8
Electrical generation										1	1
Sustainable Farms					5		1	1			
Governmental structure, Regidurias, Communal Houses, House of Local Government	9	4	1	1	10	1	2	1		3	3
Church or Chapel	15	6	2	2	19	3	3	2		7	6
Stop of Buses					1						
Electrical posts					32						
Pozo (subterranean Water reserve)											
Permanent bridges, Pedestrian Bridge, Suspension bridge	8	7	3	3	6	2	1	2	3	14	9
Telecommunication, Telephonic Antenna , Public Phone	3	2			1	1				4	3
Electrical red, Post of light					1						
TOTAL	96	46	19	19	152	21	20	13	3	77	60

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE CONSTRUCTION OF WAYS, QUARRIES, CAMPS, ETC.

LEYENDA	ESTIMACIONES DE MATERIALES EN HECTÁREAS, CANTOS RODADOS, CANTO B, ETC.										QUARRIES AND BORROWING			
	INDIO		ALTO INDIO		Terá 1		Terá		Indio		CAÑO SUCIO	TOABRÉ		
	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50			
Water														
Pasture														
Cultivos														
Shrubland, Stubble														
Secondary Forest														
Mature Forest														
Without Information														
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			0.0

TOTAL OF INFRASTRUCTURES AFFECTED BY THE OPTIONS

LEYEND	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Drinkable water, Distribution, Storage, Source, Tanks of Water reservation	2.0	0.0	0.0	0.0	2.0	0.0	10.0	8.0	13.0	11.0	11.00	2.00
Sewers	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Recreational area, Football camps, Baseball parks, Parks.	6.0	4.0	2.0	2.0	6.0	4.0	11.0	9.0	13.0	11.0	12.00	6.00
Roads	15.0	8.0	6.0	6.0	15.0	8.0	20.0	13.0	20.0	13.0	0.00	0.00
Cemetery	8.0	4.0	3.0	3.0	8.0	4.0	12.0	8.0	16.0	12.0	12.00	3.00
Clinics or health post	3.0	1.0	0.0	0.0	3.0	1.0	5.0	3.0	5.0	3.0	3.00	3.00
Dining room, School Dining rooms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.00	5.00
Commerce/Manufacturer/Agroindustrial	16.0	7.0	1.0	1.0	16.0	7.0	22.0	13.0	23.0	14.0	27.00	8.00
School	11.0	3.0	1.0	1.0	11.0	3.0	19.0	11.0	19.0	11.0	16.00	7.00
Electrical generation	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	1.0	0.00	0.00
Sustainable Farms	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.00	2.00
Governmental structure, Regidurias, Communal Houses, House of Local Government	9.0	4.0	1.0	1.0	9.0	4.0	12.0	7.0	12.0	7.0	12.00	4.00
Church or Chapel	15.0	6.0	2.0	2.0	15.0	6.0	21.0	12.0	22.0	13.0	22.00	8.00
Stop of Buses	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.00
Electrical posts	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	32.00	0.00
Pozo (subterranean Water reserve)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Permanent bridges, Pedestrian Bridge, Suspension bridge	8.0	7.0	3.0	3.0	11.0	10.0	17.0	16.0	25.0	24.0	7.00	5.00
Telecommunication, Telephonic Antenna , Public Phone	3.0	2.0	0.0	0.0	3.0	2.0	6.0	5.0	7.0	6.0	1.00	1.00
Electrical red. Post of light	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	0.00
TOTAL	96.0	46.0	19.0	19.0	99.0	49.0	156.0	106.0	176.0	126.0	172.0	54.0

POPULATION

Province, District and Corregimiento	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
Coclé								
Antón								237
1. El Valle	237	237	0	0	237	0	0	237
La Pintada								23
3. Llano Grande	0	0	0	0	0	0	23	23
Penonomé								22118
6. Chiguirí Arriba	423	423	0	0	211	0	6691	7114
7. Pajonal	0	0	0	0	0	0	158	158
8. Río Indio	2353	633	0	0	0	1294	395	4042
9. Toabré	0	0	0	0	0	0	8930	8930
10. Tulú	0	0	0	0	0	0	1874	1874
Colón								789
Chagres								374
11. La Encantada	374	90	0	0	0	0	0	374
Donoso								415
13. Coclé del Norte	0	0	0	0	0	0	217	217
14. El Guásimo	0	0	0	0	0	198	0	198
Panamá								3680
Capira.								3680
19. Cirí de Los Sotos	631	631	408	0	0	0	0	631
20. Cirí Grande	1784	1784	663	663	588	0	0	1784
21. El Cacao	50	50	50	50				50
22. Santa Rosa	1215	1215	826	0	0	0	0	1215
	7067	5063	1947	713	1036	1492	18288	26847

TOTAL OF HOUSINGS POTENCIALLY AFECTED BY THE RESERVOIRS

Province, District and Corregimiento	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Coclé											
Antón											
1. El Valle											
La Pintada											
3. Llano Grande											
Penonomé											
6. Chiguirí Arriba								50			
7. Pajonal											
8. Río Indio	894	549	132	132					524	193	193
9. Toabré										489	489
10. Tulú										408	408
Colón											
Chagres											
11. La Encantada	332	326	90	90							
Donoso											
13. Coclé del Norte										101	101
14. El Guásimo									78		
Panamá											
Capira.											
19. Ciri de Los Sotos	342	64	94	64	335	335					
20. Ciri Grande								382			
21. El Cacao											
22. Santa Rosa					669	183					
	1,568.0	939.0	316.0	286.0	1,004.0	518.0	382.0	50.0	602.0	1,191.0	1,191.0

TOTAL OF POPULATION POTENTIALLY AFFECTED BY THE OPTIONS.

Province, District and Corregimiento	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Coclé												
Antón												
1. El Valle												
La Pintada												
3. Llano Grande												
Penonomé												
6. Chiguirí Arriba												
7. Pajonal												
8. Río Indio	894.0	549.0	132.0	132.0	1418.0	1073.0	1087.0	742.0	1611.0	1266.0		
9. Toabré							489.0	489.0	489.0	489.0		
10. Tulú							408.0	408.0	408.0	408.0		
Colón												
Chagres												
11. La Encantada	332.0	326.0	90.0	90.0	332.0	326.0	332.0	326.0	332.0	326.0		
Donoso												
13. Coclé del Norte							101.0	101.0	101.0	101.0		
14. El Guásimo					78.0	78.0			78.0	78.0		
Panamá												
Capira.												
19. Cirí de Los Sotos	342.0	64.0	94.0	64.0	342.0	64.0	342.0	64.0	342.0	64.0	335.00	335.00
20. Cirí Grande											382.00	382.00
21. El Cacao												
22. Santa Rosa											669.00	183.00
	1568.0	939.0	316.0	286.0	2170.0	1541.0	2759.0	2130.0	3361.0	2732.0	1386.0	900.0

HOUSING

Province, District and Corregimiento	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
Coclé								4258
Antón								46
1. El Valle	46	46	0	0	46	0	0	46
La Pintada								8
2. Llano Grande	0	0	0	0	0	0	8	8
Penonomé								4204
3. Chiguirí Arriba	62	62	0	0	29	0	1134	1196
4. Pajonal	0	0	0	0	0	0	35	35
5. Río Indio	449	123	0	0	0	252	79	780
6. Toabré	0	0	0	0	0	0	1836	1836
7. Tulú	0	0	0	0	0	0	357	357
Colón								163
Chagres								84
8. La Encantada	84	19	0	0	0	0	0	84
Donoso								79
9. Coclé del Norte	0	0	0	0	0	0	38	38
10. El Guásimo	0	0	0	0	0	41	0	41
Panamá								705
Capira.								705
11. Cirí de Los Sotos	144	144	101	0	0	0	0	144
12. Cirí Grande	328	328	122	122	107	0	0	328
13. El Cacao	12	12	12	12				12
14. Santa Rosa	221	221	147	0	0	0	0	221
	1346	955	382	134	182	293	3487	5126

TOTAL OF HOUSING POTENTIALLY AFFECTED BY THE RESERVOIR

Province, District and Corregimiento	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
	80-40	45-40	50-40	45-40	155	130	2	Cabecera	100-90	100-90	95-50
Coclé											
Antón											
1. El Valle											
La Pintada											
3. Llano Grande											
Penonomé											
6. Chiguirí Arriba								7			
7. Pajonal											
8. Río Indio	177	109	29	29					96	39	39
9. Toabré										111	111
10. Tulú										78	78
Colón											
Chagres											
11. La Encantada	72	71	19	19							
Donoso											
13. Coclé del Norte										18	18
14. El Guásimo											15
Panamá											
Capira.											
19. Ciri de Los Sotos	78	19	24	19	77	77					
20. Ciri Grande								69			
21. El Cacao											
22. Santa Rosa					115	28					
	327.0	199.0	72.0	67.0	192.0	105.0	69.0	7.0	111.0	246.0	246.0

TOTAL OF HOUSINGS POTENTIALLY AFFECTED BY THE OPTIONS

Province, District and Corregimiento	Option 1	Option 2	Option 3	Option 4	Option 5	Option 6	Option 7	Option 8	Option 9	Option 10	Option 11	Option 12
Coclé												
Antón												
1. El Valle												
La Pintada												
3. Llano Grande												
Penonomé												
6. Chiguirí Arriba												
7. Pajonal												
8. Río Indio	177.0	109.0	29.0	29.0	273.0	205.0	216.0	148.0	312.0	244.0		
9. Toabré							111.0	111.0	111.0	111.0		
10. Tulú							78.0	78.0	78.0	78.0		
Colón												
Chagres												
11. La Encantada	72.0	71.0	19.0	19.0	72.0	71.0	72.0	71.0	72.0	71.0		
Donoso												
13. Coclé del Norte							18.0	18.0	18.0	18.0		
14. El Guásimo					15.0	15.0			15.0	15.0		
Panamá												
Capira.												
19. Ciri de Los Sotos	78.0	19.0	24.0	19.0	78.0	19.0	78.0	19.0	78.0	19.0	77.00	77.00
20. Ciri Grande											69.00	69.00
21. El Cacao												
22. Santa Rosa											115.00	28.00
	327.0	199.0	72.0	67.0	438.0	310.0	573.0	445.0	684.0	556.0	261.0	174.0

POPULATION

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
Coclé									
Antón									198
1. El Valle									198
	La Mesa	39	39			39			
	Alto De La Mesa	198	198			198			198
La Pintada									23
3. Llano Grande									23
	La Poclora						1		1
	El Espino						7		7
	La Tulua (P2)						5		5
	La Colonia						10		10
Penonomé									
6. Chiguirí Arriba									7114
	Boca De Las Minas						455		455
	Boca De Vaquilla						91		91
	Brazo Chico						32		32
	Brazo De U (P2)						75		75
	Chiguirí Arriba						912		912
	Chiguirí Centro						226		226
	Larguillo Abajo						68		68
	Larguillo Arriba						152		152
	La Vieja						128		128
	Palmilla						290		290
	Quebrada Grande						73		73
	Rio Indio Arriba (P2)						15		15
	San Miguel Arriba						398		398
	San Miguel Centro						710		710
	San Pedro (2)						593		593
	San Pedro Abajo (P1)						22		22
	Tavidal Abajo						292		292
	Tavidal Arriba						437		437
	U Arriba						177		177
	La Vaquilla						779		779
	Cerro Congoso						10		10
	Cocobari						68		68
	El Zapotal						8		8
	Larguillo Centro						164		164
	San Miguelito (Los Cajones)						71		71
	Renacimiento De U						166		166
	El Congal						39		39

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Los Pilares (P)							24	24
	Peña Blanca							76	76
	San Miguel (P2)							12	12
	Sacramento							42	42
	Santa Ana Arriba (P)							86	86
	Barrio Unido	149	149			149			149
	El Vallecito (P2)	212	212						212
	El Limon D2	62	62			62			62
7. Pajonal									158
	Atre No.1 (P1)							43	43
	Atre Arriba							58	58
	El Desecho							51	51
	Larguillo Abajo (P)							6	6
8. Rio Indio									4042
	Alto Limon							52	52
	Boca De La Encantada (P3)							193	193
	Bajo Pifa							3	3
	Gurbe							44	44
	La Pedregosa							18	18
	U Abajo							33	33
	Los Rodeos							52	52
	Alto Del Mora	16							16
	Boca De Uracillo	92							92
	Boca Del Silencio	9							9
	Alto De Uracillo	31	31						31
	El Ladrillal De San Cristobal	27	27						27
	El Aguila	36							36
	El Barrero	2	2						2
	La Calabaza	14	14						14
	Coquillo Centro (El Coquillo)	64							64
	La Arenosa	85	85						85
	El Limon No.1 (P)	14							14
	Cabecera De Las Marias	46	46						46
	Pon La Olla	8							8
	El Silencio No.1	68							68
	El Silencio Chico (El Silencio N	21							21
	La Hormiguera	27							27
	La Mona D1	29	29						29
	La Sardina	41	41						41
	Las Canoas	27							27
	Las Marias D1	36							36

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Las Marías Arriba	107							107
	Las Potreras	40	40						40
	Las Quebradas De Uracillo	57							57
	La Tollosa D2	83							83
	Loma De La Cigarra	3							3
	Los Molejones D1	37	37						37
	Manguesal D1	3	3						3
	Palma Real	61							61
	Uracillo No.2	46							46
	Piedra Amarilla D1	16	16						16
	Quebrada El Macho	8							8
	Quebrada Jacumilla	61							61
	Quebrada La Conga	11							11
	Quebrada La Palma	25							25
	Coquillo De Uracillo (Rio Coquillo)	67							67
	Rio Indio (P)	27	27						27
	San Cristobal	79	79						79
	Silencito	45							45
	Tierra Buena D1	11							11
	Tres Hermanas (2)	9							9
	U Centro D2	132							132
	Uracillo No.1	20							20
	Alto Silencio	64							64
	Las Lajas D2	19							19
	El Limite	74							74
	El Vallecito (P1)	35	35						35
	La Mina	88	88						88
	La Tollosita	47							47
	Los Naranjitos	33	33						33
	Coquillo Abajo	83							83
	El Harino	17							17
	El Silencio	75							75
	El Silencio Arriba	24							24
	Pueblo Nuevo	11							11
	Silencio De Las Marias	28							28
	Uracillo Centro	61							61
	Uracillo De Las Marias	38							38
	Boca De Paso Carnal	15							15
	Los Elegidos (El Caraño O...)						84		84
	Alto Limon						52		52
	Las Palmas (Alto Rieci O...)						24		24

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Alto De Rieciro						149		149
	El Aji						12		12
	El Faldar						27		27
	El Pantano						20		20
	Cerro Miguel (Nº2)						73		73
	La Pita						21		21
	Sabaneta De U (P)						74		74
	Campo Alegre						10		10
	Loma Alta						79		79
	Los Zules (Los Hules)						154		154
	Paso Carnal (Pasacarnal)						33		33
	Valle Del Platanal (Platanal)						111		111
	El Quebraon						23		23
	Rieciro Abajo						42		42
	La Guinea Arriba						13		13
	La Negrita						14		14
	Las Cruces						22		22
	Las Maravillas (P)						3		3
	Los Cerritos						20		20
	Los Rastrojos						32		32
	Samaria						6		6
	La Puente						77		77
	Boquilla De La Mina						16		16
	Boquilla De Quebraon						8		8
	Cigüa						29		29
	Santa Maria (P)						44		44
	Caño Sucio (Santa Maria O...)						6		6
	Cacique (El...)						16		16
9. Toabré									8930
	Chiguirí Abajo						197		197
	La Boca De Tulu						105		105
	Caðazas N° 1						68		68
	Alto De San Miguel						42		42
	Atre No.1 (P)						129		129
	Banazo Centro						69		69
	Banacito						123		123
	Banazo Arriba						14		14
	Bito						87		87
	Boca De Chiguirý						164		164
	Boca De Lura						164		164
	Boca De San Miguel						5		5

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Alica							2	2
	Chicagua							22	22
	Gato Espino							22	22
	Nuevo San Pablo							93	93
	San Isidro							129	129
	Tul Centro							278	278
	Union Santeña							40	40
	La Boca De Tulu (P)							10	10
	Nuevo Rosario							50	50
	Nuevo San Antonio							99	99
	Piedra Amarilla D2							10	10
	Agua Fria							13	13
	Los Villarretas							17	17
	Tacuma							12	12
Colón									0
Chagres									0
11. La Encantada	El Dominical	7							7
	El Limón N No.1 (P)	113							113
	Torno Abajo	12							12
	El Jordan	15							15
	Piedra Amarilla	22							22
	El Tornito	65							65
	Tres Hermanas (1)	6							6
	El Torno	24							24
	Quebrada Los Cedros	1							1
	Cerro Benito	1							1
	Los Frailes	53	53						53
	Cerro Hinojal	18							18
	Los Uveros (P)	37	37						37
Donoso									
13. Coclé del Norte	Cerro Verde							61	61
	Santa Elena							66	66
	La Ingresa							12	12
	La Tomasa							7	7
	Boca De La Encantada (P2)							48	48
	El Desfiladero							7	7
	Los Tres Cabos.							14	14
	Quebrada De Los Nietos							2	2
14. El Guásimo	Boquilla De Escobal						12		12
	Chorrerita						12		12
	Los Chorritos De Santa Maria						19		19

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Cerro Miguel De Donoso						55		55
	Las Maravillas (P)						61		61
	Santa Maria (P)						5		5
	Las Cruces						12		12
	La Raspadura						22		22
Panamá									
Capira.									
19. Ciri de Los Sotos									578
	Alto Del Naranjo	32	32	32					32
	La Bonga o El Cruce (El Bong)	53	53	53					
	Cerro El Clavo	17	17						17
	Los Uveros (P)	27	27						27
	Los Uveros Arriba	30	30						30
	Quebrada La Conga Arriba (Quebrada La Conga)	53	53	53					53
	Riecito Abajo	14	14						14
	Santa Rosa No.1 (P1)	30	30	30					30
	Teria No.3	35	35	8					35
	Tres Hermanas (3)	196	196	196					196
	Tres Hermanas Arriba	20	20	20					20
	El Hinojal Arriba	41	41						41
	Quebrada La Conga Abajo	37	37						37
	El Ahogado	16	16	16					16
	El Zahino	30	30						30
20. Ciri Grande									
	El Cedro	18	18	18	18				18
	Caracolar	57	57	57	57				57
	Río Indio Centro	165	165			165			165
	Jordanal (Quebrada Jordanal)	193	193			193			193
	Teria	142	142	142	142				142
	Las Claras Arriba	392	392						392
	Quebrada Aguacate	6	6	6	6				6
	Quebrada Escobal	22	22	22	22				22
	Río Indio De Los Chorros	141	141						141
	Teria Nacimiento (P2) (Teria A)	91	91	91	91				91
	Bajo Grande (Teriacito)	64	64	64	64				64
	Río Indio Nacimiento	39	39			39			39
	Pacorita	15	15	15	15				15
	Boca De Escobal	10	10	10	10				10
	Cerro San Andres	24	24	24	24				24
	Ciricito Arriba (P) (...Abajo)	160	160	160	160				

Province, District and Corregimiento	Populated Place	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTALES
	Arenilla (Quebrada Arenilla)	111	111			111			111
	Rio Indio Cabecera	44	44			44			44
	El Ahogado	42	42	42	42				42
	Rio Indio Arriba (P1)	36	36			36			36
	Teriacito	4	4	4	4				4
	Escobalito	8	8	8	8				8
21. El Cacao	Teria Nacimiento (P1) (Teria A)	50	50	50	50				50
22. Santa Rosa	Bajo Bonito	4	4						4
	Bella Vista O La Sanguijuela	128	128	128					128
	El Ahogado O El Almendro	114	114	114					114
	La Pita	45	45						45
	Las Claras Abajo	71	71						71
	Las Claras Centro	40	40						40
	Los Raudales (P)	72	72	72					72
	Nuevo Limon	55	55	55					55
	Quebrada Bonita (La Cachorra)	54	54						54
	Quebrada Limon	52	52	52					52
	Riecito Abajo (P1)	144	144						144
	Riecito Arriba	43	43	43					43
	San Juan (1)	31	31						31
	Santa Rosa No.1 (P2)	131	131	131					131
	Santa Rosa No.2	231	231	231					231
		7067	5063	1947	713	1036	1492	18288	26847

HOUSING

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
Coclé									
Antón									39
1. El Valle									39
	La Mesa	7	7			7			
	Alto De La Mesa	39	39			39			39
La Pintada									8
3. Llano Grande									8
	La Poclorá						1	1	
	El Espino						2	2	
	La Tulúa (P2)						2	2	
	La Colonia						3	3	
Penonomé									
6. Chiguirí Arriba									1196
	Boca De Las Minas						76	76	
	Boca De Vaquilla						14	14	
	Brazo Chico						5	5	
	Brazo De U (P2)						13	13	
	Chiguirí Arriba						133	133	
	Chiguirí Centro						41	41	
	Larguillo Abajo						12	12	
	Larguillo Arriba						25	25	
	La Vieja						22	22	
	Palmilla						51	51	
	Quebrada Grande						13	13	
	Río Indio Arriba (P2)						3	3	
	San Miguel Arriba						68	68	
	San Miguel Centro						119	119	
	San Pedro (2)						106	106	
	San Pedro Abajo (P1)						5	5	
	Tavidal Abajo						61	61	
	Tavidal Arriba						71	71	
	U Arriba						30	30	
	La Vaquilla						120	120	
	Cerro Congoso						4	4	
	Cocobari						15	15	
	El Zapotal						2	2	
	Larguillo Centro						31	31	
	San Miguelito (Los Cajones)						16	16	
	Renacimiento De U						24	24	
	El Congal						7	7	

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Los Pilares (P)							5	5
	Peña Blanca							12	12
	San Miguel (P2)							3	3
	Sacramento							7	7
	Santa Ana Arriba (P)							20	20
	Barrio Unido	20	20			20			20
	El Vallecito (P2)	33	33						33
	El Limón D2	9	9			9			9
7. Pajonal									35
	Atre No.1 (P1)							7	7
	Atre Arriba							12	12
	El Desecho							15	15
	Larguillo Abajo (P)							1	1
8. Río Indio									780
	Alto Limón							12	12
	Boca De La Encantada (P3)							39	39
	Bajo Pifa							1	1
	Gurbe							8	8
	La Pedregosa							3	3
	U Abajo							6	6
	Los Rodeos							10	10
	Alto Del Mora	3							3
	Boca De Uracillo	22							22
	Boca Del Silencio	3							3
	Alto De Uracillo	5	5						5
	El Ladrillal De San Cristóbal	6	6						6
	El Aguila	7							7
	El Barrero	1	1						1
	La Calabaza	2	2						2
	Coquillo Centro (El Coquillo)	15							15
	La Arenosa	17	17						17
	El Limón No.1 (P)	3							3
	Cabeceira De Las Marias	5	5						5
	Pon La Olla	2							2
	El Silencio No.1	12							12
	El Silencio Chico (El Silencio No.2)	3							3
	La Hormiguera	5							5
	La Mona D1	5	5						5
	La Sardina	11	11						11
	Las Canoas	5							5
	Las Marias D1	8							8

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Las Marías Arriba	19							19
	Las Poteras	8	8						8
	Las Quebradas De Uracillo	10							10
	La Tollosa D2	16							16
	Loma De La Cigarrá	1							1
	Los Molejones D1	6	6						6
	Manguesal D1	1	1						1
	Palma Real	10							10
	Uracillo No.2	11							11
	Piedra Amarilla D1	3	3						3
	Quebrada El Macho	2							2
	Quebrada Jacumilla	9							9
	Quebrada La Conga	2							2
	Quebrada La Palma	6							6
	Coquillo De Uracillo (Rio Coquillito)	14							14
	Rio Indio (P)	5	5						5
	San Cristobal	17	17						17
	Silencito	8							8
	Tierra Buena D1	2							2
	Tres Hermanas (2)	2							2
	U Centro D2	25							25
	Uracillo No.1	3							3
	Alto Silencio	11							11
	Las Lajas D2	3							3
	El Limite	19							19
	El Vallecito (P1)	7	7						7
	La Mina	17	17						17
	La Tollosita	8							8
	Los Naranjitos	7	7						7
	Coquillo Abajo	12							12
	El Harino	2							2
	El Silencio	12							12
	El Silencio Arriba	4							4
	Pueblo Nuevo	2							2
	Silencio De Las Marias	6							6
	Uracillo Centro	9							9
	Uracillo De Las Marias	7							7
	Boca De Paso Carnal	3							3
	Los Elegidos (El Caraño O...)						15		15
	Alto Limon						12		12
	Las Palmas (Alto Rieci O...)						5		5

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Alto De Rieciro						27		27
	El Aji						3		3
	El Faldar						6		6
	El Pantano						6		6
	Cerro Miguel (Nº2)						14		14
	La Pita						5		5
	Sabaneta De U (P)						17		17
	Campo Alegre						1		1
	Loma Alta						16		16
	Los Zules (Los Hules)						32		32
	Paso Carnal (Pasacarnal)						6		6
	Valle Del Platanal (Platanal)						20		20
	El Quebraon						4		4
	Rieciro Abajo						8		8
	La Guinea Arriba						3		3
	La Negrita						4		4
	Las Cruces						4		4
	Las Maravillas (P)						1		1
	Los Cerritos						4		4
	Los Rastrojos						3		3
	Samaria						1		1
	La Puente						14		14
	Boquilla De La Mina						3		3
	Boquilla De Quebraon						2		2
	Cigüa						5		5
	Santa Maria (P)						7		7
	Caño Sucio (Santa Maria O...)						1		1
	Cacique (El...)						3		3
9. Toabré									1836
	Chiguirí Abajo						35		35
	La Boca De Tulu						22		22
	Cañazas N° 1						14		14
	Alto De San Miguel						12		12
	Atre No.1 (P)						29		29
	Banazo Centro						18		18
	Banacito						24		24
	Banazo Arriba						5		5
	Bito						21		21
	Boca De Chiguiry						37		37
	Boca De Lura						34		34
	Boca De San Miguel						1		1

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Chorrerita							17	17
	San Pedro Abajo (P2)						5	5	
	San Jose						12	12	
	San Pablo						17	17	
	Atre N° 2						17	17	
	Boca De Guayabo						5	5	
	Boca De Larguillo						4	4	
	Cabecera De Quebrada La Tortuga						3	3	
	Cabecera De Quebrada Los Manueles						1	1	
	Cerro Venturilla						4	4	
	El Pernal						2	2	
	Guabal Arriba						10	10	
	La Chispa						5	5	
	Las Marias D2						12	12	
	Los Pilares						9	9	
	Monte Buena						4	4	
	Quebrada El Clavo						3	3	
	Quebrada El Corotu O Quebrada La Minga						6	6	
	Quebrada El Tigre						1	1	
	Quebrada La Tabila						5	5	
	Quebrada La Vaca						4	4	
	Quebrada Lajosa						4	4	
	Quebrada Los Sules						3	3	
	Quebrada Sardinosa						4	4	
	San Miguel N° 2						5	5	
	San Miguelito						8	8	
	San Pablo Abajo						8	8	
	San Pablo Arriba						15	15	
	El Bajito						46	46	
	Cabecera De Rio Bito						1	1	
	La Candelaria						76	76	
10. Tulú									
	Boca De Cuiria						23	23	
	La Marina						22	22	
	Buena Vista						16	16	
	La Tulua (P1)						31	31	
	Lubre						6	6	
	Lura Centro						56	56	
	Lura Arriba						23	23	
	Tulu Abajo						9	9	
	Tulu Arriba						16	16	

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Alica							1	1
	Chicagua							3	3
	Gato Espino							4	4
	Nuevo San Pablo							20	20
	San Isidro							24	24
	Tul Centro							50	50
	Union Santeña							10	10
	La Boca De Tulu (P)							2	2
	Nuevo Rosario							10	10
	Nuevo San Antonio							19	19
	Piedra Amarilla D2							2	2
	Agua Fria							3	3
	Los Villarretas							4	4
	Tacuma							3	3
Colón									0
Chagres									0
11. La Encantada	El Dominical	2							2
	El Lim ^{3/4} N No.1 (P)	27							27
	Torno Abajo	3							3
	El Jordan	4							4
	Piedra Amarilla	5							5
	El Tornito	12							12
	Tres Hermanas (1)	1							1
	El Torno	5							5
	Quebrada Los Cedros	1							1
	Cerro Benito	1							1
	Los Frailes	9	9						9
	Cerro Hinjal	4							4
	Los Uveros (P)	10	10						10
Donoso									
13. Coclé del Norte	Cerro Verde							11	11
	Santa Elena							13	13
	La Inglesa							1	1
	La Tomasa							1	1
	Boca De La Encantada (P2)							8	8
	El Desfiladero							1	1
	Los Tres Cabos.							2	2
	Quebrada De Los Nietos							1	1
14. El Guásimo	Boquilla De Escobal						3		3
	Chorrerita						2		2
	Los Chorritos De Santa María						3		3

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Cerro Miguel De Donoso						13		13
	Las Maravillas (P)						12		12
	Santa Maria (P)						1		1
	Las Cruces						2		2
	La Raspadura						5		5
Panamá									
Capira.									
19. Ciri de Los Sotos									132
	Alto Del Naranjo	7	7	7					7
	La Bonga o El Cruce (El Bongo Arriba)	12	12	12					
	Cerro El Clavo	2	2						2
	Los Uveros (P)	10	10						10
	Los Uveros Arriba	8	8						8
	Quebrada La Conga Arriba (Quebrada La Conga)	12	12	12					12
	Rieciito Abajo	2	2						2
	Santa Rosa No.1 (P1)	8	8	8					8
	Teria No.3	8	8	8					8
	Tres Hermanas (3)	48	48	48					48
	Tres Hermanas Arriba	4	4	4					4
	El Hinojal Arriba	7	7						7
	Quebrada La Conga Abajo	9	9						9
	El Ahogado	2	2	2					2
	El Zahino	5	5						5
20. Ciri Grande	El Cedro	3	3	3	3				3
	Caracolar	10	10	10	10				10
	Río Indio Centro	27	27			27			27
	Jordanal (Quebrada Jordanal)	32	32			32			32
	Teria	29	29	29	29				29
	Las Claras Arriba	70	70						70
	Quebrada Aguacate	1	1	1	1				1
	Quebrada Escobal	4	4	4	4				4
	Río Indio De Los Chorros	29	29						29
	Teria Nacimiento (P2) (Teria Arriba)	13	13	13	13				13
	Bajo Grande (Teriacito)	10	10	10	10				10
	Rio Indio Nacimiento	9	9			9			9
	Pacorita	3	3	3	3				3
	Boca De Escobal	2	2	2	2				2
	Cerro San Andres	4	4	4	4				4
	Circito Arriba (P) (...Abajo)	32	32	32	32				32

Province, District and Corregimiento	Lugar Poblado (POPULATED PLACE)	Indio	Alto Indio	Teria 1	Teria 2	Indio Cab	C Sucio	Toabré	TOTAL
	Arenilla (Quebrada Arenilla)	20	20			20			20
	Rio Indio Cabecera	10	10			10			10
	El Ahogado	9	9	9	9				9
	Rio Indio Arriba (P1)	9	9			9			9
	Teriacito	1	1	1	1				1
	Escobalito	1	1	1	1				1
21. El Cacao	Teria Nacimiento (P1) (Teria Arriba)	12	12	12	12				12
22. Santa Rosa	Bajo Bonito	1	1						1
	Bella Vista O La Sanguijuela	22	22	22					22
	El Ahogado O El Almendro	22	22	22					22
	La Pita	10	10						10
	Las Claras Abajo	14	14						14
	Las Claras Centro	6	6						6
	Los Raudales (P)	13	13	13					13
	Nuevo Limon	12	12	12					12
	Quebrada Bonita (La Cachorra)	10	10						10
	Quebrada Limon	7	7	7					7
	Riecito Abajo (P1)	27	27						27
	Riecito Arriba	10	10	10					10
	San Juan (1)	6	6						6
	Santa Rosa No.1 (P2)	21	21	21					21
	Santa Rosa No.2	40	40	40					40
		1346	955	382	134	182	293	3487	5126

Total of Hectares by Agrological Class of Soil.

HECTARES

LEYEND		RÍO INDIÓ	ALTO INDIÓ	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL
III	Arable, severe limitations in the selection of the plants, it needs special conservation or both.	346.9	346.9			357.7876			346.9
IV	Arable, very severe limitations in the selection of the plants, it needs very careful handling or both.	5.2	5.2	0.7				3,570.0	3,575.3
VI	Not arable, with severe limitations, suitable for forests, grasslands, grounds of reservations.	10,560.6	7,736.0	4228.6	1992.2	1224.25	8,299.2	13,773.8	32,633.6
VII	Not arable, with very severe limitations suitable for forests, grasslands, grounds of reservations	27,610.0	18,151.8	5173.4	1570.9	4504.062	963.8	32,891.5	61,465.3
VIII	Not arable, with limitations that prevent his use in the production of commercial plants.	137.6					2,575.9	22,628.1	25,341.6
	TOTAL	38,660.3	26,239.9	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.6

TOTAL OF HECTARES POTENCIALLY AFECTED BY THE RESERVOIRS.

LEYEND		INDIO		ALTO INDIO		Terá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
		80-40	45-40	50-40	45-40	155	130				100-90	100-90
III	Arable, severe limitations in the selection of the plants, it needs special conservation or both.											
IV	Arable, very severe limitations in the selection of the plants, it needs very careful handling or both.						0.10					
VI	Not arable, with severe limitations, suitable for forests, grasslands, grounds of reservations.	2,516.2	1,515.6	689.2	648.3	677.45	405.29	490.32	106.208	1,322.7	1394.8	1,250.1
VII	Not arable, with very severe limitations suitable for forests, grasslands, grounds of reservations	2,022.2	578.4	162.6	135.9	698.77	354.72	334.22	4.628	21.6	1874.6	1,224.1
VIII	Not arable, with limitations that prevent his use in the production of commercial plants.									10.3	1665.9	951.0
	TOTAL	4,538.3	2,093.9	851.7	784.2	1,376.3	760.0	824.5	110.8	1,354.5	4,935.3	3,425.1

TOTAL OF HECTARES POTENCIALLY AFFECTED BY THE CONSTRUCTION OF ROADS, QUARRIES, CAMPS, ETC.

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYEND		Opción 1	Opción 2	Opción 3	Opción 4	Opción 5	Opción 6	Opción 7	Opción 8	Opción 9	Opción 10	Opción 11	Opción 12
III	Arable, severe limitations in the selection of the plants, it needs special conservation or both.	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4	0.00	0.00
IV	Arable, very severe limitations in the selection of the plants, it needs very careful handling or both.	220.3	220.3	220.3	220.3	220.3	220.3	220.3	220.3	220.3	220.3	203.10	203.00
VI	Not arable, with severe limitations, suitable for forests, grasslands, grounds of reservations.	2960.7	1960.1	1,133.7	1,092.8	4354.7	3354.1	4235.8	3235.2	5774.6	4774.0	1604.87	1472.91
VII	Not arable, with very severe limitations suitable for forests, grasslands, grounds of reservations	2302.6	858.8	443.0	416.3	2327.5	883.7	3562.3	2118.5	4237.8	2794.0	1286.79	974.07
VIII	Not arable, with limitations that prevent his use in the production of commercial plants.	0.0	0.0	0.0	0.0	20.7	20.7	969.8	969.8	1705.4	1705.4	0.00	0.00
TOTAL		5487.9	3043.5	1,801.3	1,733.8	6,927.6	4,483.3	8,992.6	6,548.3	11,942.6	9,498.2	3,094.8	2,650.0

Total of Hectares by actual Landuse
HECTARES

LEYEND	RÍO INDIOS	ALTO INDIOS	TERIA 1	TERIA 2	INDIO CAB.	CAÑO SUCIO	TOABRÉ	TOTAL
Water	150.9	84.0	0.00				7.5	158.4
grassland and Pasture	9,369.6	6,211.2	2352.2	549.55	1177.118	3,396.8	28,378.1	41,144.5
Crops	685.3	1,133.2	190.1	24.01		96.2	700.2	1,481.7
Shrubland, Stubble	13,749.1	8,052.1	2916.1	1324.23	3,472.5	3,299.6	25,102.9	42,151.7
Secondary Forest	11,623.8	445.2	3051.8	1326.3	1182.408	1,716.3	12,501.4	25,841.4
Mature Forest	1,440.9	9,845.5	591.7	247.7	223.8022	120.3	1,704.3	3,265.5
Without information	1,640.4	468.5	300.7	91.28	30.2	3,209.7	4,468.8	9,319.0
TOTAL	38,659.9	26,239.7	9,402.7	3,563.1	6,086.1	11,838.9	72,863.4	123,362.3

TOTAL OF HECTARES POTENCIALLY AFFECTED BY THE CONSTRUCTION OF ROADS, QUARRIES, CAMPS, ETC.

LEYEND	INDIO		ALTO INDIO		Teria 1		Teria	Indio	CAÑO SUCIO	TOABRÉ		Quarries & Borrowing
	80-40	45-40	50-40	45-40	155.00	130.00	2.00	Cabecera	100-90	100-90	95-50	
Water	0.14	0.14	0.14	0.14								16.17
grassland and Pasture	45.17	45.17	45.17	45.17	6.67	6.67	20.30	23.72	23.31	22.79	22.79	161.99
Crops	1.27	1.27	1.27	1.27	0.01	0.01	0.68	0.88	0.58	0.62	0.62	7.88
Shrubland, Stubble	27.41	27.41	27.41	27.41	2.55	2.55	7.59	14.99	16.52	31.31	31.31	267.59
Secondary Forest	16.82	16.82	16.82	16.82			7.88	11.34	10.01	13.94	13.94	135.80
Mature Forest	2.10	2.10	2.10	2.10					0.75	2.25	2.25	9.06
Without information	16.28	16.28	16.28	16.28			7.77	9.88	31.94	8.69	8.69	241.23
TOTAL	109.19	109.19	109.19	109.19	9.23	9.23	44.22	60.81	83.11	79.60	79.60	839.72

TOTAL OF HECTARES POTENCIALLY AFECTED BY THE RESERVOIRS

LEYEND	INDIO		ALTO INDIO		Teriá 1		Teria	Indio	CAÑO SUCIO	TOABRÉ	
	80-40	45-40	50-40	45-40	155	130				100-90	100-90
Water	135.0	147.5	92.8	92.5		384.85	137.99	33.37		7.5	7.5
grassland and Pasture	1,731.3	812.3	331.1	301.0	653.9	17.74	3.95		389.1	1,784.4	1,218.8
Crops	62.0	10.4	5.8	4.5	32.7	211.05	269.26	54.23	12.3	68.7	43.4
Shrubland, Stubble	1,347.3	573.3	212.1	193.3	371.5	132.63	346.96	22.90	282.6	1,605.9	1,148.0
Secondary Forest	922.1	345.6	173.3	159.0	284.4	3.11	30.64	0.34	90.4	705.5	525.4
Mature Forest	62.2	32.3	14.8	14.2	6.5	10.61	35.75		4.6	33.8	21.9
Without information	278.5	172.6	21.8	19.7	27.3		35.80		575.5	729.5	460.1
TOTAL	4,538.3	2,093.9	851.7	784.2	1,376.3	760.0	860.3	110.8	1,354.5	4,935.3	3,425.1

TOTAL OF HECTARES POTENTIALLY AFFECTED BY THE OPTIONS

LEYENDA	Opción 1	Opción 2	Opción 3	Opción 4	Opción 5	Opción 6	Opción 7	Opción 8	Opción 9	Opción 10	Opción 11	Opción 12
Water	135.0	147.5	92.8	92.5	135.0	147.5	142.4	154.9	142.4	154.9	137.99	556.21
grassland and Pasture	1731.3	812.3	331.1	301.0	2120.4	1201.4	2950.1	2031.1	3904.8	2985.8	657.81	21.69
Crops	62.0	10.4	5.8	4.5	74.3	22.7	105.4	53.8	143.0	91.4	301.97	534.54
Shrubland, Stubble	1347.3	573.3	212.1	193.3	1629.9	855.9	2495.3	1721.3	3235.8	2461.8	718.47	502.49
Secondary Forest	922.1	345.6	173.3	159.0	1012.5	436.0	1447.5	871.0	1718.0	1141.5	315.06	34.09
Mature Forest	62.2	32.3	14.8	14.2	66.7	36.9	84.1	54.2	100.6	70.7	42.29	46.36
Without information	278.5	172.6	21.8	19.7	854.0	748.1	738.5	632.6	1583.5	1477.6	63.06	35.80
TOTAL	4538.3	2093.9	851.7	784.2	5,892.9	3,448.5	7,963.4	5,519.1	10,828.2	8,383.8	2,236.7	1,731.2

Option 1 (INDIO 80-40)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	11
Center of health	200	250	50,000	1000	0.50	500	50,500	3
Recreative Area			0	1900	0.50	950	950	6
Cemetery			0	1560	0.50	780	780	8
Church	129	250	32,250	200	0.50	100	32,350	15
Junta Comunal	60	250	15,000	100	0.50	50	15,050	9
							E =	1,482,640

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents	1.00	90,000	
Dry seasons	18.80	20,000	
Footpath	71.80	2,000	
			C = 609,600

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Unitary Cost	Total by		Nº
				Unit	Nº	
Telephonic antenna	1	-	5.000	5,000	3	15,000
Posts of light	0	-	0	-	0	-
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	0	-
Bridge of Concrete	meters	0	2.000	two ways	0	-
Woody Bridge	meters	3	500	one way	8	12,000
Kiosk (Traded)	m ²	20	50		16	16,000
Stop of buses	m ²	25	50		0	-
Telephone box	1	-	7000		3	21,000
Tank of storage	Gallon	5000	1		2	10,000
				I =		74,000

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 2,166,240

Option 2 (INDIO 45-40)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	3
Center of health	200	250	50,000	1000	0.50	500	50,500	1
Recreative Area			0	1900	0.50	950	950	4
Cemetery			0	1560	0.50	780	780	4
Church	129	250	32,250	200	0.50	100	32,350	6
Junta Comunal	60	250	15,000	100	0.50	50	15,050	4
							E =	502,220

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents		90,000	0
Dry seasons	8.70	20,000	174,000
Footpath	40.80	2,000	81,600
			C = 255,600

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Units	Dimension	Unitary Cost	Total by Unit		Nº
Telephonic antenna	1	-	5,000	5,000	2	10,000
Posts of light	0	-	0	-	0	-
Suspension bridge	metros	8	250	Madera (Peatonal ¿?)	2,000	7
Bridge of Concrete	metros	0	2,000	Dos carriles	-	0
Woody Bridge	metros	3	500	Un carril	1,500	0
Kiosk (Traded)	m ²	20	50		1,000	7
Stop of buses	m ²	25	50		1,250	0
Telephone box	1	-	7000		7,000	0
Tank of storage	Galón	5000	1		5,000	0
				I =	31,000	

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) =

788,820

Option 3: ALTO INDIO 50-40

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	1
Center of health	200	250	50,000	1000	0.50	500	50,500	-
Recreative Area			0	1900	0.50	950	950	2
Cemetery			0	1560	0.50	780	780	3
Church	129	250	32,250	200	0.50	100	32,350	2
Junta Comunal	60	250	15,000	100	0.50	50	15,050	1
								E = 147,490

Roads	Km	B/.-Km	To introduce in these cells the length, in kilometres, which it corresponds to every type of road
Permanents		90,000	0
Dry seasons	4.40	20,000	88,000
Footpath	8.40	2,000	16,800
			C = 104,800

Facilities	Unit	Dimension	Unitary	Cost	Madera (Peatonal ¿?)	Total by Unit	Nº
			Total by Unit				
Telephonic antenna	1	-	5,000	5,000	-	-	-
Posts of light	0	-	0	0	-	-	-
Suspension bridge	meters	8	250	2,000	3	6,000	
Bridge of Concrete	meters	0	2,000	Dos carriles	0	-	
Woody Bridge	meters	3	500	Un carril	0	-	
Kiosk (Traded)	m ²	20	50	1,000	1	1,000	
Stop of buses	m ²	25	50	1,250	0	-	
Telephone box	1	-	7000	7,000	0	-	
Tank of storage	Gallon	5000	1	5,000	0	-	
			I =	7,000			

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 259,290

Option 4: ALTO INDIO 45-40

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	1
Center of health	200	250	50,000	1000	0.50	500	50,500	-
Recreative Area			0	1900	0.50	950	950	2
Cemetery			0	1560	0.50	780	780	3
Church	129	250	32,250	200	0.50	100	32,350	2
Junta Comunal	60	250	15,000	100	0.50	50	15,050	1
							E =	147,490

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents		90,000	0
Dry seasons	3.60	20,000	72,000
Footpath	7.80	2,000	15,600
			C = 87,600

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	Unitary Cost	Total by Unit		Nº
Telephonic antenna	1	-	5,000	5,000	0	-
Posts of light	0	-	0	-	0	-
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)	2,000	3
Bridge of Concrete	meters	0	2,000	two way	-	0
Woody Bridge	meters	3	500	one way	1,500	0
Kiosk (Traded)	m ²	20	50		1,000	1
Stop of buses	m ²	25	50		1,250	0
Telephone box	1	-	7000		7,000	0
Tank of storage	Gallon	5000	1		5,000	0
				I =	7,000	

El tamaño del tanque de agua debe ser en volumen (galones)

Gran Total (E + C + I) = 242,090

Option 5 (INDIO 80-40, CAÑO SUCIO 100-90)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/. M ²	S Total 1	M ²	B/. M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	11
Center of health	200	250	50,000	1000	0.50	500	50,500	3
Recreative Area			0	1900	0.50	950	950	6
Cemetery			0	1560	0.50	780	780	8
Church	129	250	32,250	200	0.50	100	32,350	15
Junta Comunal	60	250	15,000	100	0.50	50	15,050	9
								E = 1,482,640

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents	1.00	90,000	
Dry seasons	18.80	20,000	
Footpath	95.00	2,000	
			C = 656,000

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Unitary Cost	Total by Unit		Nº	Total
				Unit	Nº		
Telephonic antenna	1	-	5,000	5,000	3	15,000	
Posts of light	0	-	0	-	0	-	
Suspension bridge	meters	8	250	Woody(Peatonal ¿?)	0	-	
Bridge of Concrete	meters	0	2,000	two ways	0	-	
Woody Bridge	meters	3	500	one way	11	16,500	
Kiosk (Traded)	m ²	20	50		16	16,000	
Stop of buses	m ²	25	50		0	-	
Telephone box	1	-	7000		3	21,000	
Tank of storage	Gallon	5000	1		2	10,000	
			I = 78,500				

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 2,217,140

Option 6: (INDIO 45-40, CAÑO SUCIO 100-90)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	\$ Total 1	M ²	B/.-M ²	\$ Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	3
Center of health	200	250	50,000	1000	0.50	500	50,500	1
Recreative Area			0	1900	0.50	950	950	4
Cemetery			0	1560	0.50	780	780	4
Church	129	250	32,250	200	0.50	100	32,350	6
Junta Comunal	60	250	15,000	100	0.50	50	15,050	4
							E =	502,220

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents		90,000	0
Dry seasons	8.70	20,000	174,000
Footpath	64.00	2,000	128,000
			C = 302,000

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Costo	Total por Unidad	Nº
			Unitario		
Telephonic antenna	1	-	5.000	5,000	2
Posts of light	0	-	0	-	0
Suspension bridge	meters	8	250	Woddy (Peatonal ¿?)	2,000
Bridge of Concrete	meters	0	2,000	two way	-
Woody Bridge	meters	3	500	one way	1,500
Kiosk (Traded)	m ²	20	50		1,000
Stop of buses	m ²	25	50		1,250
Telephone box	1	-	7000		7,000
Tank of storage	Gallon	5000	1		0
				I =	37,000

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) =

841,220

Option 7: (INDIO 80, TOABRÉ 95-50)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº	E =
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2			
School	250	250	62,500	2000	0.50	1000	63,500	19	1,206,500
Center of health	200	250	50,000	1000	0.50	500	50,500	5	252,500
Recreative Area			0	1900	0.50	950	950	11	10,450
Cemetery			0	1560	0.50	780	780	12	9,360
Church	129	250	32,250	200	0.50	100	32,350	21	679,350
Junta Comunal	60	250	15,000	100	0.50	50	15,050	12	180,600
									E = 2,338,760

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents	1.00	90,000	
Dry seasons	18.80	20,000	
Footpath	127.20	2,000	
			C = 720,400

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Unitary		Total by		Nº
			Cost		Unit		
Telephonic antenna	1	-	5,000		5,000		-
Electric generation	0		2,000		2,000		1
Posts of light	meters	-	0		-		0
Suspension bridge	meters	8	250	Woddy (Peatonal ?)	2,000		0
Bridge of Concrete	meters	0	2,000	two ways	-		0
Woody Bridge	meters	3	500	one way	1,500		17
Kiosk (Traded)	m ²	20	50		1,000		22
Stop of buses	m ²	25	50		1,250		
Telephone box	1	-	7000		7,000		6
Tank of storage	Galón	5000	1		5,000		10
						I =	141,600

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 3,200,660

Option 8: (INDIO 45-40, TOABRÉ 95-50)

To introduce in these cells the quantity that corresponds to every type of building.

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	11
Center of health	200	250	50,000	1000	0.50	500	50,500	3
Recreative Area			0	1900	0.50	950	950	9
Cemetery			0	1560	0.50	780	780	8
Church	129	250	32,250	200	0.50	100	32,350	12
Junta Comunal	60	250	15,000	100	0.50	50	15,050	7
							E =	1,358,340

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents	0.00	90,000	0
Dry seasons	8.70	20,000	174,000
Footpath	96.20	2,000	192,400
			C = 366,400

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	Cost	Unitary		Total by Unit	Nº	
Telephonic antenna	1	-	5,000			5,000	5	25,000
Electric generation			2,000			2,000	1	2,000
Posts of light	0	-	0			-	0	-
Suspension bridge	meters	8	250	Woody (Peatonal ¿?)		2,000	16	32,000
Bridge of Concrete	meters	0	2,000	two ways		-	0	-
Woody Bridge	meters	3	500	one way		1,500	20	30,000
Kiosk (Traded)	m ²	20	50			1,000	13	13,000
Stop of buses	m ²	25	50			1,250		
Telephone box	1	-	7000			7,000	0	-
Tank of storage	Gallon	5000	1			5,000	8	40,000
						I =		142,000

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 1,866,740

Option 9: (INDIO 80-40, CAÑO SUCIO 100-90, TOABRE 100-90)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	19
Center of health	200	250	50,000	1000	0.50	500	50,500	5
Recreative Area			0	1900	0.50	950	950	13
Cemetery			0	1560	0.50	780	780	16
Church	129	250	32,250	200	0.50	100	32,350	22
Junta Comunal	60	250	15,000	100	0.50	50	15,050	12
							E =	2,376,130

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km	
Permanents	1.30	90,000	
Dry seasons	18.80	20,000	
Footpath	176.70	2,000	
			C = 846,400

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Unitary	Woddy (Peatonal ¿?)	two way	one way	Total by	Nº
			Cost				Unit	
Telephonic antenna	1	-	5,000				5,000	3
Electric generation			2,000				2,000	1
Posts of light	0	-	0				-	0
Suspension bridge	meters	8	250	Woddy (Peatonal ¿?)	2,000		0	-
Bridge of Concrete	meters	0	2,000	two way	-		0	-
Woody Bridge	meters	3	500	one way			1,500	25
Kiosk (Traded)	m ²	20	50				1,000	23
Stop of buses	m ²	25	50				1,250	0
Telephone box	1	-	7000				7,000	7
Tank of storage	Gallon	5000	1				5,000	13
							I =	191,500

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 3,414,030

Option 10: (INDIO 45-40, CAÑO SUCIO 100-90, TOABRÉ 100-90)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B./-M ²	\$ Total 1	M ²	B./-M ²	\$ Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	11
Center of health	200	250	50,000	1000	0.50	500	50,500	3
Recreative Area			0	1900	0.50	950	950	11
Cemetery			0	1560	0.50	780	780	12
Church	129	250	32,250	200	0.50	100	32,350	13
Junta Comunal	60	250	15,000	100	0.50	50	15,050	7
								E = 1,395,710

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B./-Km	
Permanents		90,000	
Dry seasons	8.70	20,000	
Footpath	145.70	2,000	
			C = 465,400

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimension	Unitary Cost	Total by Unit		Nº	\$
Telephonic antenna	1	-	5,000	5,000	6	30,000	
Electric generation			2,000	2,000	1	2,000	
Posts of light	0	-	0	-	0	-	
Suspension bridge	meters	8	250	Woody (Peatonal ?) two ways	24	48,000	
Bridge of Concrete	meters	0	2,000	one way	0	-	
Woody Bridge	meters	3	500	1,500	0	-	
Kiosk (Traded)	m ²	20	50	1,000	14	14,000	
Stop of buses	m ²	25	50	1,250	0	-	
Telephone box	1	-	7000	7,000	-	-	
Tank of storage	Gallon	5000	1	5,000	11	55,000	
				I =		149,000	

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 2,010,110

Option 11: (TERIA, ALTO TERIA)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	6
Center of health	200	250	50,000	1000	0.50	500	50,500	2
Recreative Area			0	1900	0.50	950	950	5
Cemetery			0	1560	0.50	780	780	2
Church	129	250	32,250	200	0.50	100	32,350	6
Junta Comunal	60	250	15,000	100	0.50	50	15,050	7
							E =	787,760

To introduce in these cells the length, in kilometres, which it corresponds to every type of road.

Roads	Km	B/.-Km	
Permanents		90,000	0
Dry seasons		20,000	0
Footpath		2,000	0
			C = 0

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation:

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	Unitary Cost	Total by		Nº
				Unit	Nº	
Telephonic antenna	1	-	5,000	5,000	1	5,000
Electric generation			2,000	2,000		-
Posts of light	0	-	0	-	0	-
Suspension bridge	meters	8	250	Woody (Peatonal ?)	3	6,000
Bridge of Concrete	meters	0	2,000	two ways	0	-
Woody Bridge	meters	3	500	one way	0	-
Kiosk (Traded)	m ²	20	50		7	7,000
Stop of buses	m ²	25	50		0	-
Telephone box	1	-	7000		0	-
Tank of storage	Gallon	5000	1		2	10,000
				I =		28,000

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 815,760

Option 12: (TERIA, ALTO TERIA, INDIO CABECERA)

To introduce in these cells the quantity that corresponds to every type of building

Buildings	Construction			Terrain			Total 1+2	Nº
	M ²	B/.-M ²	S Total 1	M ²	B/.-M ²	S Total 2		
School	250	250	62,500	2000	0.50	1000	63,500	6
Center of health	200	250	50,000	1000	0.50	500	50,500	2
Recreative Area			0	1900	0.50	950	950	5
Cemetery			0	1560	0.50	780	780	2
Church	129	250	32,250	200	0.50	100	32,350	7
Junta Comunal	60	250	15,000	100	0.50	50	15,050	7
							E =	820,110

To introduce in these cells the length, in kilometres, which it corresponds to every type of road

Roads	Km	B/.-Km		
Permanents		90,000		0
Dry seasons		20,000		0
Footpath		2,000		0
			C =	0

To introduce in these cells the costs of every unit of measurement that corresponds to every type of installation

To introduce in these cells the quantity that corresponds to every type of building

Facilities	Unit	Dimensión	Unitary Cost	Total by Unit		Nº
Telephonic antenna	1	-	5.000	5,000	1	5,000
Electric generation			2.000	2,000		-
Posts of light	0	-	0	-	0	-
Suspension bridge	meters	8	250	Woody	2,000	4
Bridge of Concrete	meters	0	2.000	two ways	-	0
Woody Bridge	meters	3	500	one way	1,500	0
Kiosk (Traded)	m ²	20	50		1,000	7
Stop of buses	m ²	25	50		1,250	0
Telephone box	1	-	7000		7,000	-
Tank of storage	Gallon	5000	1		5,000	2
				I =	30,000	

The size of the water tank must be in volume (gallons)

Gran Total (E + C + I) = 850,110

ANNEX 4-B

Options	1	2	3	4	Caño Sucio	Toabre	Toabre	Teriá	Alto Teriá	Cabecera I
Parameter	Indio x=80 - y=40	Indio x=45 - y=40	Alto Indio x=50 - y=40	Alto Indio x=45 - y=40	Caño Sucio x=100 - y=90	Toabre x = 100-y=90	Toabre x=95 - y=50	Teriá x=130-y=90	Alto Teriá x=265-y=220	Cabecera I x=300-y=290
Acuena (10^6 m^2)	381.00	381.00	262.00	262.00	111.00	727.00	727.00	94.00	35.63	60.86
Qmedio (m^3/seg)	25.80	25.80	17.70	17.70	7.50	40.80	40.80	7.41	3.35	6.44
Qs ($\text{m}^3/\text{m}^2\text{*año}$)	2.14	2.14	2.13	2.13	2.13	1.77	1.77	2.49	2.97	3.34
Y ($10^6 \text{ m}^3/\text{año}$)	813.63	813.63	648.37	648.37	233.37	1,290.00	1,290.00	233.80	105.60	203.20
Vx (10^6 m^3)	1,577.00	404.00	126.60	86.40	73.00	1,131.00	850.00	285.00	245.00	20.00
Ax (10^6 m^2)	45.60	20.94	8.52	7.84	13.56	49.35	34.25	7.56	8.17	1.10
T (años)	1.94	0.50	0.20	0.13	0.31	0.88	0.66	1.22	2.32	0.10
Zx (metros)	34.58	19.29	14.86	11.02	5.38	22.92	24.82	37.70	29.99	18.18
$T^{0.75}/3 Zx$	0.016	0.010	0.007	0.007	0.026	0.013	0.010	0.010	0.021	0.003
Lpx ($\text{gr}/\text{m}^2/\text{año}$)	0.09	0.20	0.33	0.36	0.09	0.15	0.22	0.13	0.05	0.57
Lpx x 1.2	0.11	0.24	0.40	0.43	0.11	0.18	0.27	0.16	0.06	0.69
Lp/Zx	0.0032	0.0123	0.0266	0.0390	0.0202	0.0080	0.0107	0.0043	0.0019	0.0378
Fósforo (ug/l) (x)	0.0017	0.0024	0.0026	0.0029	0.0028	0.0024	0.0026	0.0017	0.0012	0.0022
clorofila a (ug/l)	0.15	0.23	0.25	0.28	0.27	0.23	0.25	0.14	0.09	0.20
Penetración luz (m)	-15.21	-15.14	-15.12	-15.09	-15.09	-15.14	-15.12	-15.22	-15.27	-15.16
Agotamiento Oxigeno	0.17	0.33	0.43	0.59	1.10	0.28	0.28	0.15	0.15	0.33

Options	5	6	7	8	9	10	11	12	Options	Bayano (62-50)	Âlajuela (77-61)
Parameter	CS-I (1)	CS-I (2)	T-I (1)	T-I (2)	T-CS-I (1)	T-CS-I (2)	Subbasin Teriá	Sub. Teriá Cabec. Indio	Parameter		
Acuena (10^6 m^2)	381.00	381.00	381.00	381.00	381.00	381.00	94.00	94.00	Acuena (10^6 m^2)	3,771.70	952.00
Qmedio (m^3/seg)	31.80	31.80	65.80	65.80	71.80	71.80	7.41	13.85	Qmedio (m^3/seg)	158.00	54.00
Qs ($\text{m}^3/\text{m}^2*\text{año}$)	2.63	2.63	5.45	5.45	5.94	5.94	2.49	4.65	Qs ($\text{m}^3/\text{m}^2*\text{año}$)	1.32	1.79
Y ($10^6 \text{ m}^3/\text{año}$)	1047.00	1047.00	2103.63	2103.63	2337.00	2337.00	233.80	437.00	Y ($10^6 \text{ m}^3/\text{año}$)	4,982.69	1,702.94
Vx (10^6 m^3)	1577.00	404.00	1577.00	404.00	1577.00	404.00	285.00	285.00	Vx (10^6 m^3)	4,787.10	765.00
Ax (10^6 m^2)	45.60	20.94	45.60	20.94	45.60	20.94	7.56	7.56	Ax (10^6 m^2)	352.90	49.00
T (años)	1.51	0.39	0.75	0.19	0.67	0.17	1.22	0.65	T (años)	0.60	0.32
Zx (metros)	34.58	19.29	34.58	19.29	34.58	19.29	37.70	37.70	Zx (metros)	13.57	15.61
$T^{0.75}/3 Zx$	0.013	0.008	0.008	0.005	0.007	0.005	0.010	0.006	$T^{0.75}/3 Zx$	0.017	0.009
Lpx (gr/ $\text{m}^2/\text{año}$)	0.12	0.56	0.26	0.28	0.26	0.62	0.16	0.19	Lpx (gr/ $\text{m}^2/\text{año}$)	0.11	0.33
Lp/Zx	0.0035	0.0290	0.0075	0.0145	0.0075	0.0321	0.0042	0.0050	Lp/Zx	0.0081	0.0211
Fósforo (ug/l) (x)	0.0016	0.0047	0.0020	0.0014	0.0019	0.0029	0.0016	0.0012	Fósforo (ug/l) (x)	0.0018	0.0030
Clorofila a (ug/l)	0.13	0.51	0.18	0.12	0.17	0.28	0.14	0.10	Clorofila a (ug/l)	0.16	0.29
Penetración luz (m)	-15.23	-14.86	-15.1823	-15.25	-15.20	-15.09	-15.22	-15.27	Penetración luz (m)	-15.20	-15.07
	0.16	0.47	0.18	0.25	0.17	0.36	0.15	0.13		0.39	0.45

Total load of phosphorus to the reservoir, in tons per year and in grams for m² per year, from not punctual sources in the basin of the Indio river.

Forest Cover and Actual Use of the Soil	Reservoir Area	Reservoir Area	Watershed Area	Coefficient of exportation	Loads
	(km ²) 80-40	(km ²) 45-40	(km ²)	(grams/m ² /year)	(tons / year)
Urban			0.10	0.10	0.01
Agriculture			6.85	0.05	0.34
Grasslands and Stubbles			249.00	0.01	2.49
Forest			130.65	0.01	1.31
Total =	45.60	20.94	386.60		4.15
loads of phosphorus 80-40 por m ² =					0.09 gr/m ² /year
Load to 45-40 por m ² =					0.20 gr/m ² /year
Loads to 40 por m ² =					0.23 gr/m ² /year

ALTO INDIO

Forest Cover and Actual Use of the Soil	Reservoir Area	Reservoir Area	Watershed Area	Coefficient of exportation	Loads
	(km ²) 50-40	(km ²) 45-40	(km ²)	(grams/m ² /year)	(tons / year)
Urban			0.10	0.10	0.01
Agriculture			4.45	0.05	0.22
Grasslands and Stubbles			166.00	0.01	1.66
Forest			91.85	0.01	0.92
Total =	8.52	7.84	262.40		2.81
loads of phosphorus 50-40 por m ² =					0.33 gr/m ² /year
Load to 45-40 por m ² =					0.36 gr/m ² /year

TERIA

Forest Cover and Actual Use of the Soil	Reservoir Area	Reservoir Area	Watershed Area	Coefficient of exportation	Loads
	(km ²)		(km ²)	(grams/m ² /year)	(tons / year)
Urban			0.10	0.10	0.01
Agriculture			1.90	0.05	0.10
Grasslands and Stubbles			55.59	0.01	0.55
Forest			36.43	0.01	0.36
Total =	7.56		94.02		1.02
loads of phosphorus by m ² =					0.13 gr/m ² /year

ALTO TERIA

Forest Cover and Actual Use of the Soil	Reservoir Area	Reservoir Area	Watershed Area	Coefficient of exportation	Loads
	(km ²)		(km ²)	(grams/m ² /year)	(tons / year)
Urban			0.10	0.10	0.01
Agriculture			0.24	0.05	0.01
Grasslands and Stubbles			19.55	0.01	0.20
Forest			15.74	0.01	0.16
Total =	8.17		35.63		0.38
loads of phosphorus by m ² =					0.05 gr/m ² /year

INDIO CABECERA

Forest Cover and Actual Use of the Soil	Reservoir Area (km ²)		Watershed Area (km ²)	Coefficient of exportation (grams/m ² /year)	Loads (tons / year)
Urban			0.10	0.10	0.01
Agriculture			0.10	0.05	0.01
Grasslands and Stubbles			46.60	0.01	0.47
Forest			14.06	0.01	0.14
Total =	1.10		60.86		0.63
			loads of phosphorus by m ² =	0.57 gr/m ² /year	

Total load of phosphorus in tons a year to the reservoir, from punctual sources in the basin of the Indio river.

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	7,641	1.57 kg/person/day	12.00
Cow	7587	17.60 kg/cattlehead/year	133.53
Pigs	933	3.23 kg/cattlehead/year	3.01
Chicken	21382	0.09 kg/person/day	1.92
		Total =	150.47
		Loads / m ² of Watershed =	0.389

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	7,641	1.57 kg/person/day	12
Cow	7587	17.60 kg/cattlehead/year	134
Pigs	933	3.23 kg/cattlehead/year	3
Chicken	21382	0.09 kg/person/day	2
		Total =	150.47
		Loads / m ² of Watershed =	0.573

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	1979	1.57 kg/person/day	3
Cow	1522	17.60 kg/cattlehead/year	27
Pigs	176	3.23 kg/cattlehead/year	1
Chicken	6270	0.09 kg/person/day	1
		Total =	31.03
		Loads / m ² of Watershed =	0.330

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	713	1.57 kg/person/day	1
Cow	584	17.60 kg/cattlehead/year	10
Pigs	94	3.23 kg/cattlehead/year	0
Chicken	2354	0.09 kg/person/day	0
		Total =	11.91
		Loads / m ² of Watershed =	0.334

Source	Number (persons or cattle heads)	loads of phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons / year)
Domestic	1036	1.57 kg/person/day	2
Cow	750	17.60 kg/cattlehead/year	13
Pigs	122	3.23 kg/cattlehead/year	0
Chicken	3026	0.09 kg/person/day	0
		Total =	15.49
		Loads / m ² of Watershed =	0.255

Total load of phosphorus to the reservoir, in tons per year and in grams per m² by year, from no puntual sources in the basin of Caño Sucio River.

Forest Cover and Actual Use of the Soil	Reservoir Area (km ²) 100-90	Watershed Area (km ²)	Coefficient of exportation (grams/m ² /year)	Loads (tons /year)
Urban		0.10	0.10	0.01
Agriculture		1.00	0.05	0.05
Grassland and Stubbles		99.00	0.01	0.99
Forest		18.30	0.01	0.18
Total =	13.56	118.40		1.23
Loads of phosphorus m ² =				0.09 gr/m ² /year

Total Load of Phosphorus in Tons a Year to the Reservoir, from Puntual Sources in the Caño Sucio River.

Source	Number (persons or cattle heads)	Loads of Phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons/year)
Domestic	1,738	1.57 kg/persona/día	2.73
Cows	628	17.60 kg/cabeza/año	11.05
Pigs	170	3.23 kg/cabeza/año	0.55
Chicken	965	0.09 kg/persona/día	0.09
		Total = 14.42	
		Loads / m ² of watershed = 0.122	

Total load of phosphorus to the reservoir, in tons per year and in grams per m² by year, from no puntual sources in the basin of Toabre River.

Forest Cover and Actual Use of the Soil	Reservoir Area (km ²) 100	Reservoir Area (km ²) 95	Reservoir Area (km ²) 90	Reservoir Area (km ²) 50	Reservoir Area (km ²)	Coefficient of exportation (grams/m ² /year)	Loads (tons / year)
Urban					0.10	0.10	0.01
Agriculture					7.00	0.05	0.35
Grassland and Stubbles					579.50	0.01	5.80
Forest					142.00	0.01	1.42
Total =	49.35	34.25	31.10	5.10	728.60		7.58
Load of phosphorus by m ² =						0.15 gr/m ² / year	
Load level 95 =						0.22 gr/m ² / year	
Load level 90 =						0.24 gr/m ² / year	
Load level 50 =						1.49 gr/m ² / year	

Total Load of Phosphorus in Tons a Year to the Reservoir, from Puntual Sources in the Toabre River.

Source	Number (persons or cattle heads)	Loads of Phosphorus per capita (kg/person/year or kg/cattle head/year)	Load Total (tons/year)
Doméstico	1,601	1.57 kg/person/day	2.51
Vacuno	2,033	17.60 kg/cattle head/year	35.78
Cerdos	507	3.23 kg/cattle head/year	1.64
Pollo	3,629	0.09 kg/person/day	0.33
Total =			40.26
Load/ m ² of watershed =			0.055

ANNEX 4-C

Table 4-2
Summary of the Geologic, Geotechnical and Seismic Risks
For The Construction Stage and for the Area of Direct Influence

Options	Landslides	Tunnel Infiltration	Waste Disposal	Dam Infiltration	Earthquakes	Total Risk Score
1	3	1	3	2	1	10
2	1	1	1	1	1	5
5	2	1	2	2	1	8
6	1	1	1	1	1	5
7	2	1	2	2	1	8
8	1	1	1	1	1	5
9	3	1	3	3	1	11
10	3	1	2	3	1	10

1 = minor; 2 = medium; 3 = major.

Table 4-3
Potential impacts on soils that would be affected by the water options
 considered for the Indio, Caño Sucio and Toabre rivers watersheds

COMPONENT	CLASS					TOTAL		
	III	IV	VI	VII	VIII			
Indio River Roads	4.4	17.3	31.2	56.3	0.0		109.2	
Reservoir 80-40	0.0	0.0	2,516.2	2,022.2	0.0		4,538.3	
Reservoir 45-40	0.0	0.0	1,515.6	578.4	0.0		2,093.9	
Caño Sucio Roads	0.0	0.0	71.4	3.4	10.4		85.1	
Reservoir			1,322.7	21.6	10.3		1,354.5	
Toabré Roads	0.0	0.0	25.1	35.7	18.8		79.6	
Reservoir 100-90	0.0	0.0	1394.8	1874.6	1665.9		4,935.3	
Reservoir 95-50	0.0	0.0	1,250.1	1,224.1	951.0		3,425.1	
Borrow Sites	0.0	203.0	327.4	165.3	0.0		695.6	
Sand quarry	0.0	0.0	0.0	58.8	0.0		58.8	
Fluvial deposits	0.0	0.0	85.9	0.0	0.0		85.9	
Opciones								
CLASS / DESCRIPTION	1	2	5	6	7	8	9	10
III Arable, severe limitations in the selection of plants, requires special conservation or both	4.4	4.4	4.4	4.4	4.4	4.4	4.4	4.4
IV Arable, very severe limitations in the selection of plants, needs very careful management or both	220.3	220.3	17.3	17.3	17.3	17.3	17.3	17.3
VI Not arable, with severe limitations, suitable for forests, grasslands, reservation lands	2,960.7	1,959.9	2572.3	1571.7	3822.6	2822	5361.3	4360.7
VII Not arable, with very severe limitations suitable for forests, grasslands, reservation lands	2,302.5	858.7	2099.1	655.3	3338.2	1894.4	4013.6	2569.8
VIII Not arable, with limitations that prevent its use in the production of commercial plants	0.0	0.0	1439.6	1439.6	969.8	969.8	1705.4	1705.4
TOTAL	5,487.90	3,043.30	6,132.7	3,688.30	8,152.20	5,707.80	11,102.00	8,657.70

Table 4-4
Summary of the soil impacts for the construction and operation stages and for
the areas of direct and indirect influence

Options	Soils Flooded by the Dam(s)	Soils affected by Quarries, Earth Borrow Sites, and Roads	Soils affected by Induced Development	Total Score
1	3	2	3	8
2	2	2	3	7
5	2	2	2	6
6	1	1	2	4
7	2	2	2	6
8	1	1	2	4
9	3	3	3	9
10	2	2	3	7

1 = minor; 2 = medium; 3 = major.

Table 4-16
Summary of Hydrological Resource Impacts of the
Water Options during the Construction and Operation Phases
in the Areas of Direct and Indirect Influence.

Options	Water Level and Flow, Downstream	Transport and Sedimentation	Risk of Eutrophication	Downstream Water Quality	Total Score
1	3	2	1	1	7
2	3	1	2	1	7
5	1	1	1	1	4
6	1	1	1	1	4
7	1	1	1	1	4
8	1	1	2	1	5
9	2	1	1	1	5
10	2	1	1	1	5

1 = minor; 2 = medium; and 3 = major.

Table 4-17
**Number of Towns potentially affected by the Emissions of Combustion Gases
and Particles by Alternative and Type of Work**

Alternative	Type of Work					Total
	Roads	Dam	Quarries	Tunnel / Channel	Dikes	
1- Indio 80-40	9	1	7	1	2	20
2- Indio 45-40	10	1	7	1	0	19
5 - Caño Sucio 100-90 Indio 80-40	20	2	9	1	2	34
6 - Caño Sucio 100-90 Indio 45-40	20	2	9	1	0	32
7 - Toabré 95-50 Indio 80-40	22	3	15	8	2	50
8 - Toabré 95-50 Indio 45-40	23	3	15	8	0	49
9 - Toabré 95-50 / Caño Sucio 100-90 / Indio 80-40	32	4	17	8	2	63
10 - Toabré 95-50 / Caño Sucio 100-90 / Indio 45-40	33	4	17	8	0	62

Notes - Detailed tables listing the towns that would be affected by each alternative are presented at the end of the chapter.

Source: Elaborated by the authors with information from the ROCC Socio-economic database and raster images of maps from the General Controller's office.

Table 4-18
Number of Targets Sensitive to Air Quality Impacts by Alternative

Alternative	Type of Infrastructure			Total
	School	Church	Health Center	
1- Indio 80-40	1	1	0	2
2- Indio 45-40	1	1	0	2
5 - Caño Sucio 100-90 Indio 80-40	2	2	1	5
6 - Caño Sucio 100-90 Indio 45-40	2	2	1	5
7 - Toabré 95-50 Indio 80-40	5	5	3	13
8 - Toabré 95-50 Indio 45-40	5	5	3	13
9 - Toabré 95-50 Caño Sucio 100-90 Indio 80-40	6	6	3	15
10 - Toabré 95-50 Sucio 100-90 Indio 45-40	6	6	3	15

Source: Elaborated by the authors with information from the ROCC Socio-economic database

Table 4-19
Summary of the impacts on air quality for the water options in the construction and operation phases in the areas of direct and indirect influence.

Options	Impact of vehicle traffic and of the movement of earth in:		Incidence of forest Fires	Total
	Towns	Sensitive locations		
1	3	1	2	6
2	3	1	2	6
5	1	1	1	3
6	1	1	1	3
7	2	3	2	7
8	2	3	1	6
9	3	3	3	9
10	3	3	2	8
5	1	1	1	3

1 = minor; 2 = medium; and 3 = major.

Table 4-20
Number of Towns Affected by Noise by Alternative and Type of Work

Alternative	Type of Work					Total
	Roads	Dam	Quarries	Tunnel / Channel	Dikes	
1- Indio 80-40	12	1	12	1	2	28
2- Indio 45-40	15	1	12	1	0	29
5 - Caño Sucio 100-90 Indio 80-40	23	2	14	1	2	42
6 - Caño Sucio 100-90 Indio 45-40	25	2	14	1	0	42
7 - Toabré 95-50 Indio 80-40	27	3	23	8	2	63
8 - Toabré 95-50 Indio 45-40	29	3	23	8	0	63
9 - Toabré 95-50 Caño Sucio 100-90 Indio 80-40	38	4	25	8	2	77
10 - Toabré 95-50 Sucio 100-90 Indio 45-40	40	4	25	8	0	77

Note - Detailed tables listing the towns that would be affected by each alternative are presented at the end of the chapter.

Source. Elaborated by the authors with information from the ROCC Socio-economic Study and raster images of maps from the General Controller's office.

Table 4-21
Number of Infrastructures Sensitive to an Increase in Noise Levels by Alternative

Alternative	Type of Infrastructure			Total
	School	Church	Health Center	
1-Indio 80-40	1	2	1	4
2-Indio 45-40	1	2	1	4
5 - Caño Sucio 100-90 Indio 80-40	2	3	2	7
6 - Caño Sucio 100-90 Indio 45-40	2	3	2	7
7 - Toabré 95-50 Indio 80-40	7	9	4	20
8 - Toabré 95-50 Indio 45-40	7	9	4	20
9 - Toabré 95-50 Caño Sucio 100-90 Indio 80-40	8	10	5	23
10-Toabré 95-50 Sucio 100-90 Indio 45-40	8	10	5	23

Source: Created by the authors with information from the Socioeconomic Database of the ROCC, 2003.

Table 4-22
Summary of noise impacts for the different water options, during the construction and operation phases and in the areas of direct and indirect influence

Options	Impact of vehicle traffic on:		Total
	Towns	Sensitive targets	
1	3	2	5
2	3	2	5
5	1	1	2
6	1	1	2
7	2	3	5
8	2	3	5
9	3	3	6
10	3	3	6

1 = minor; 2 = medium; and 3 = major.

Table 4-24
Percentage of the Total Area Affected in Each Option by Vegetation Type

OPTIONS	Forest	Pasture	Stubble
1 Indio 80-40	24.28%	40.99%	34.73%
2 Indio 45-40	22.30%	41.96%	35.74%
5 Caño Sucio 100-90, Indio 80-40	22.60%	42.41%	34.99%
6 Caño Sucio 100-90, Indio 45-40	19.93%	44.14%	35.93%
7 Toabré 95-50, Indio 80-40	22.19%	41.23%	36.58%
8 Toabré 95-50, Indio 45-40	20.41%	41.76%	37.82%
9 Toabré 100-90, Caño Sucio 100-90, Indio 80-40	20.61%	42.68%	36.71%
10 Toabré 100-90, Caño Sucio 100-90, Indio 45-40	18.84%	43.52%	37.65%

Table 4-29
Summary of Biological Diversity Impacts for the Different Water options, in the Construction and Operation Phases and in the Areas of Direct and Indirect Influence.

Options	Impact on terrestrial communities on:		Impact on aquatic communities on:		Total
	Vegetation	Fauna	Vegetation	Fauna	
1	3	3	3	2	11
2	1	2	2	2	7
5	3	2	1	2	8
6	1	1	1	1	4
7	2	1	2	2	7
8	1	1	1	1	4
9	3	2	1	3	9
10	1	1	1	3	6

1 = minor; 2 = medium; and 3 = greater

Table 4-30
Population Directly Affected by the Water Options
that Involve the Indio, Caño Sucio and Toabré Rivers

Option	Houses	Population	Comparative index of population impact
Indio 80-40	327	1,568	1.00
Indio 45-40	199	939	0.60
Caño Sucio 100-90 + Indio River 80-40	438	2,170	0.65
Caño Sucio 100-90 + Indio River 45-40	310	1,541	0.46
Toabré 95-50+ Indio River 80-40	468	2,300	0.68
Toabré 95-50+ Indio River 45-40	340	1,671	0.50
Toabré 100-90+Caño Sucio 100-90 + Indio River 80-40	684	3,361	1.00
Toabré 100-90+Caño Sucio 100-90 + Indio River 45-40	556	2,732	0.81

Table 4-31
Impact of the Options on Villages by Population Size

Option	Villages	Villages with 10 houses or more	Villages with 20 houses or more
Indio 80-40	37	14	3
Indio 45-40	23	9	2
Caño Sucio 100-90 + Indio River 80-40	56	18	3
Caño Sucio 100-90 + Indio River 45-40	42	13	2
Toabré 95-50+Indio River 80-40	57	19	6
Toabré 95-50+Indio River 45-40	38	15	6
Toabré 100-90+Caño Sucio 100-90 + Indio River 80-40	78	29	9
Toabré 100-90+Caño Sucio 100-90 + Indio River 45-40	64	24	8

Table 4-32
Potential impact on the Local Employment On the Regional GDP

Option	Number of Families	% of labor participation Balboas			Impact on GDP ¹		
		10%	25%	50%	10%	25%	50%
Indio 80-40	327	78,480	196,200	392,400	1.42%	3.54%	7.08%
Indio 45-40	199	47,760	119,400	238,800	0.86%	2.16%	4.31%
Caño Sucio 100-90 + Indio River 80-40	438	105,120	262,800	525,600	1.90%	4.74%	9.49%
Caño Sucio 100-90 + Indio River 45-40	310	74,400	186,000	372,000	1.34%	3.36%	6.72%
Toabre 95-50+ Indio River 80-40	468	112,320	280,800	561,600	2.03%	5.07%	10.14%
Toabré 95-50+ Indio River 45-40	340	81,600	204,000	408,000	1.47%	3.68%	7.37%
Toabré 100-90+Caño Sucio 100-90 + Indio River 80-40	684	164,160	410,400	820,800	2.96%	7.41%	14.82%
Toabré 100-90+Caño Sucio 100-90 + Indio River 45-40	556	133,440	333,600	667,200	2.41%	6.02%	12.04%

Table 4-33
**Summary of the Impact of the Options
on the Local Infrastructure**

Infrastructure	Indio 80-40	Indio 45-40	Caño Sucio 100-90 + Indio River 80-40	Caño Sucio 100-90 + Indio River 45-40	Toabré 95-50 + Indio River 80-40	Toabré 95-50 + Indio River 45-40	Toabré 100-90+ Caño Sucio 100-90 + Indio River 80-40	Toabré 100-90+ Caño Sucio 100-90 + Indio River 45-40
Buildings			No.	No.	No.	No.	No.	No.
School	11	3	11	3	19	11	19	11
Health Center	3	1	3	1	5	3	5	3
Recreation Area	6	4	6	4	11	9	13	11
Cemetery	8	4	8	4	12	8	16	12
Church	15	6	15	6	21	12	22	13
Communal Building	9	4	9	4	12	7	12	7
Roads	Km.	Km.	Km.	Km.	Km.	Km.	Km.	Km.
Permanent	1.00	0.00	1	0	1	0	1	0
Summer	18.80	8.70	18.8	8.7	18.8	8.7	18.8	8.7
Unimproved Trails	71.80	40.80	94.8	63.8	127.2	96.2	176.8	145.8
Facilities	No.	No.	No.	No.	No.	No.	No.	No.
Telephone antenna	3	2	3	2	6	5	7	6
Light Posts	0	0	0	0	1	1	1	1
Suspension bridge	0	7	3	10	0	7	3	10
Concrete Bridge	0	0	0	0	9	9	14	14
Wooden Bridge	8	0	8	0	8	0	8	0
Kiosk (Commercial)	16	7	16	7	16	7	16	7
Bus Stop	0	0	0	0	6	6	7	7
Telephone booth	3	0	3	0	3	0	3	0
Storage Tank	2	0	2	0	2	0	2	0

Source: URS-Holding, 2003.

¹ Evaluated over the GDP of the ROCC.

Table 4-34
Cost of the Infrastructure Affected by every Option (in Balboas)

Infrastructure	Indio 80-40	Indio 45-40	Caño Sucio 100-90 + Indio River 80-40	Caño Sucio 100-90 + Indio River 45-40	Toabré 95-50 + Indio River 80-40	Toabré 95-50+ Indio River 45-40	Toabré 100-90+ Caño Sucio 100-90 + Indio River 80-40	Toabré 100-90+ Caño Sucio 100- 90 + Indio River 45-40
Buildings								
School	698,500	190,500	698,500	190,500	1,206,500	698,500	1,206,500	698,500
Health Center	151,500	50,500	151,500	50,500	252,500	151,500	252,500	151,500
Recreation Area	5,700	3,800	5,700	3,800	10,450	8,550	12,350	10,450
Cemetery	6,240	3,120	6,240	3,120	9,360	6,240	12,480	9,360
Church	485,250	194,100	485,250	194,100	679,350	388,200	711,700	420,550
Communal Building	135,450	60,200	135,450	60,200	180,600	105,350	180,600	105,350
Roads								
Permanent	90,000	0	90,000	0	90,000	0	90,000	0
Summer	376,000	174,000	376,000	174,000	376,000	174,000	376,000	174,000
Unimproved Trails	143,600	81,600	190,000	128,000	254,400	192,400	354,000	292,000
Facilities								
Telephone Antenna	15,000	10,000	15,000	10,000	30,000	25,000	35,000	30,000
Light Posts	0	0	0	0	2,000	2,000	2,000	2,000
Suspension bridge	0	14,000	6,000	20,000	0	14,000	6,000	20,000
Concrete Bridge	0	0	0	0	18,000	18,000	28,000	28,000
Wooden Bridge	12,000	0	12,000	0	12,000	0	12,000	0
Kiosk (Commercial)	16,000	7,000	16,000	7,000	16,000	7,000	16,000	7,000
Bus Stop	0	0	0	0	6,000	6,000	7,000	7,000
Telephone booth	21,000	0	21,000	0	21,000	0	21,000	0
Storage Tank	10,000	0	10,000	0	50,000	40,000	10,000	0
Total Cost	2,166,240	788,820	2,218,640	841,220	3,214,160	1,836,740	3,333,130	1,955,710

Table 4-35
Impact of the Water Options on the Vegetation Coverage and the Land Use

Vegetation Cover	Indio 80-40	Indio 45-40	Caño Sucio 100-90 + Indio River 80- 40	Caño Sucio 100-90 + Indio River 45-40	Toabré 95-50 + Indio River 80- 40	Toabré 95-50 + Indio River 45-40	Toabré 100-90 + Caño Sucio 100- 90 + Indio River 80- 40	Toabré 100-90 + Caño Sucio 100- 90 + Indio River 45-40
Mature forest	62.2	32.3	66.8	36.9	91.6	61.7	100.6	70.8
Secondary forest	922.1	345.6	1,012.5	436.0	1,447.5	871.0	772.3	742.4
Pasture / cattle ranch	1,731.30	812.3	2,090.5	855.9	2,313.7	1,539.6	3,874.5	2,639.9
Stubble	1347.3	573.3	4,175.9	3,401.9	2,495.3	1,721.3	5,780.9	5,006.9
Crops	62.005	10.429	74.305	22.729	105.405	53.829	142.905	91.329
Approximate value (B./)	7,474,587	3,380,196	9,987,697	4,757,146	10,453,987	6,881,236	17,178,657	12,221,466

. See information for options 1 and 2 in the annexes.

Table 4-36
Implied annual value of the production affected by the water options (B/)

Option	Population	Implicit value
Indio 80-40	1,568	363,776
Indio 45-40	939	217,848
Caño Sucio 100-90 + Indio River 80-40	2,170	503,440
Caño Sucio 100-90 + Indio River 45-40	1,541	357,512
Toabré 95-50+Indio River 80-40	2,300	533,600
Toabré 95-50+Indio River 45-40	1,671	387,672
Toabré 100-90+Caño Sucio 100-90 + Indio River 80-40	3,361	779,752
Toabré 100-90+Caño Sucio 100-90 + Indio River 45-40	2,732	633,824

Table 4-38
Affected Mining Concessions

Alternatives	Concession Code	Type	Current
Indio 80-40	94-117	Metálicos	No
	94-85	Metálicos	yes
	95-91	Metálicos	yes
Indio 45-40	94-85	Metálicos	yes
	95-91	Metálicos	yes
5 – Caño Sucio 100-90, Indio 80-40	94-117	Metal	No
	94-85	Metal	Yes
	95-91	Metal	Yes
	94-87	Metal	Yes
6 - Caño Sucio 100-90, Indio 45-40	94-85	Metal	Yes
	94-87	Metal	Yes
	95-91	Metal	Yes
	94-117	Metal	No
7 – Toabré 95-50, Indio 80-40	94-85	Metal	Yes
	94-87	Metal	Yes
	94-117	Metal	No
	95-91	Metal	Yes
	95-75	Metal	Yes
8 - Toabré 95-50, Indio 45-40	94-85	Metal	Yes
	94-87	Metal	Yes
	95-75	Metal	Yes
	95-91	Metal	Yes
	94-85	Metal	Yes
9 – Toabré 100-90, Caño Sucio 100-90, Indio 80-40	94-87	Metal	Yes
	95-91	Metal	Yes
	94-117	Metal	No
	95-75	Metal	Yes
	93-75	Metal	Yes
	94-85	Metal	Yes
10 – Toabré 100-90, Caño Sucio 100-90, Indio 45-40	94-87	Metal	Yes
	94-117	Metal	No
	95-91	Metal	Yes
	95-75	Metal	Yes
	93-75	Metal	Yes

Source: Compilation Study Data base and ROCC Socioeconomic Information Presentation⁽³³⁾.

Table 4-39
**Summary of the Potential Socioeconomic Impacts of the Water Options on
 Socio-economic Aspects, during the Phases of Construction and Operation,
 in the Direct and Indirect Areas**

Options	Water offer	Employment and Revenue	Commerce and Marketing	Population Displacement	Community Cohesion	Social and Local Infrastructure	Agricultural Production	Total
1	0	1	1	3	3	3	3	14
2	3	2	1	2	2	2	2	14(11)
5	0	3	1	1	1	2	2	10
6	0	3	1	1	1	1	1	8
7	0	2	1	2	2	3	2	12
8	0	3	1	1	2	2	1	10
9	0	1	1	3	3	3	3	14
10	0	2	1	2	3	2	3	13

Table 4-41
**Number of Towns with Scenic Resources (Reported by the Communities)
 Affected by Alternative**

Alternative	Type of Work					Total
	Quarries	Dam	Tunnel / Channel	Trail	Reservoir	
Indio 80-40	0	0	0	0	11	11
Indio 45-40	0	0	0	0	7	7
5 - Caño Sucio 100-90 Indio 80-40	0	0	0	0	11	11
6 - Caño Sucio 100-90 Indio 45-40	0	0	0	0	7	7
7 - Toabré 95-50 Indio 80-40	4	1	0	0	15	20
8 - Toabré 95-50 Indio 45-40	4	1	0	0	11	16
9 - Toabré 95-50 Caño Sucio 100-90 Indio 80-40	4	1	0	0	15	20
10 - Toabré 95-50 Sucio 100-90 Indio 45-40	4	1	0	0	11	16

Source: Elaboration by the authors with information from the ROCC socioeconomic database

Table 4-42
Potentially Affected Scenic Resources by Option

Alternative	Town	Place of Local Interest	Type of Associated Activity
1- Indio 80-40	Boca de Uracillo San Cristóbal La Conga Abajo Tres Hermanas	Indio River & Uracillo Meadows Indio River, Ponds, Cascades Stones / Indigenous writings Indigenous stones, Cascades Indio River	Boat trip & swimming Trip, fishing, hunting Trip Trip Boat trip & swimming
2- Indio 45-40	Boca de Uracillo San Cristóbal La Conga Abajo	Meadows Indio River, Ponds, Cascades Stones / Indigenous writings	
5-Caño Sucio 100-90, Indio 80-40	Boca de Uracillo San Cristóbal La Conga Abajo Tres Hermanas El Torno	Indio River & Uracillo Meadows Indio River, Ponds, Cascades Stones / Indigenous writings Indigenous stones, Cascades Indio River	Boat trip & swimming Trip, fishing, hunting Trip Trip Boat trip & swimming
6-Caño Sucio 100-90, Indio 45-40	Boca de Uracillo San Cristóbal La Conga Abajo Los Uveros	Indio River & Uracillo Meadows Indio River, Ponds, Cascades Stones / Indigenous writings Geomorphological depressions	Boat trip & swimming Trip, fishing, hunting Trip Horseback riding
7-Toabré 95-50 Indio, 80-40	San Isidro San Cristóbal La Conga Abajo Banacito	La Boquilla de la Gloria; La Piedra del destiladero. Indio River, ponds, Cascades Stones / Indigenous writings Banazo River	Boat trip & swimming, Horseback riding Trip, fishing, hunting Trip Horseback riding
8-Toabré 95-50, Indio 45-40	San Cristóbal La Conga Abajo Santa Elena La Inglesia	Indio River, Ponds, Cascades Stones / Indigenous writings Santa Elena Cascades in the river	Trip, fishing, hunting Trip Ponds, Cascades, fishing. Horseback riding, rapids
9-Toabré 100-90, Caño Sucio 100-90, Indio 80-40	San Isidro Santa Elena La Inglesia Los Uveros	La Boquilla de la Gloria; La Piedra del destiladero. Santa Elena Cascades in the river Geomorphological depressions	Boat trip & swimming, Horseback riding Ponds, Cascades, fishing Ponds, Cascades, fishing Horseback riding
10-Toabré 100-90, Sucio 100-90 Indio 45-40	San Cristóbal El Tornito Santa Elena	Indio River Indio River, steep sloped hills. Santa Elena	Fishing or hunting. Horseback riding Ponds, Cascades, fishing

Note: Caño Sucio does not have scenic Resources.

ANNEX - 5

Table 5-1
Population Displacement Mitigation Costs for each water option considered in
the
Rio Indio, Caño Sucio and Toabre Watersheds

Option	Number of houses	Population	Replacement of the house (B./)	Compensation for Damages and Inconveniences (B./)	Training (B./)	Totals (B./)
Indio 80-40	327	1568	3,270,000	1,568,000	327,000	5,165,000
Indio 45-40	199	939	1,990,000	939,000	199,000	3,128,000
Caño Sucio 100-90 + Rio Indio 80-40	438	2,170	4,380,000	2,170,000	438,000	6,988,000
Caño Sucio 100-90 + Rio Indio 45-40	310	1,541	3,100,000	1,541,000	310,000	4,951,000
Toabre 95-50 + Rio Indio 80-40	468	2,300	4,680,000	2,300,000	468,000	7,448,000
Toabre 95-50 + Rio Indio 45-40	340	1,671	3,400,000	1,671,000	340,000	5,411,000
Toabre 100-90 + Caño Sucio 100-90 + Rio Indio 80-40	684	3,361	6,840,000	3,361,000	684,000	10,885,000
Toabre 100-90 + Caño Sucio 100-90 + Rio Indio 45-40	556	2,732	5,560,000	2,732,000	556,000	8,848,000

Note: Simulated costs used in the Table are: B./10,000 per replaced house; B./1,000 per person as compensation for the disturbance due to transfer (provisional), and B./500 per trained person, with an average of 2 trained people per household.

Table 5-3
Annual implicit value of the production affected by the water options in the Rio Indio, Caño Sucio, and Toabre watersheds (B./).

Option	Annual crops	Perennial crops	Total Value
Indio 80-40	197,530	498,737	696,267
Indio 45-40	118,291	298,670	416,961
Caño Sucio 100-90 + Rio Indio 80-40	273,368	690,216	963,584
Caño Sucio 100-90 + Rio Indio 45-40	194,129	490,149	684,278
Toabre 95-50 + Rio Indio 80-40	289,745	731,566	1,021,310
Toabre 95-50 + Rio Indio 45-40	210,506	531,498	742,004
Toabre 100-90 + Caño Sucio 100-90 + Rio Indio 80-40	423,405	1,069,040	1,492,445
Toabre 100-90 + Caño Sucio 100-90 + Rio Indio 45-40	344,166	868,973	1,213,139

Table 5-4
**Replacement cost of the social infrastructure by water option in the Rio Indio,
Caño Sucio, and Toabre watersheds (B.)**

<i>Infrastructure</i>	Indio 80-40	Indio 45-40	Caño Sucio 100- 90 + Rio Indio 80- 40	Caño Sucio 100- 90 + Rio Indio 45- 40	Toabre 95-50 + Rio Indio 80-40	Toabre 95-50 + Rio Indio 45-40	Toabre 100-90+ Caño Sucio 100- 90 + Rio Indio 80- 40	Toabre 100-90+ Caño Sucio 100- 90 + Rio Indio 45- 40
Schools	698,500	190,500	698,500	190,500	1,206,500	698,500	1,206,500	698,500
Health Centers	151,500	50,500	151,500	50,500	252,500	151,500	252,500	151,500
Recreational Areas	5,700	3,800	5,700	3,800	10,450	8,550	12,350	10,450
Cemeteries	18,720	9,360	18,720	9,360	28,080	18,720	37,440	28,080
Churches	485,250	194,100	485,250	194,100	679,350	388,200	711,700	420,550
Community meeting areas	135,450	60,200	135,450	60,200	180,600	105,350	180,600	105,350
Total	1,495,120	508,460	1,495,120	508,460	2,357,480	1,370,820	2,401,090	1,414,430

Note: Unit costs used for infrastructure are presented in Annex 5. Cemeteries costs include: 25% for the replacement land and 75% for transfer costs of the human remains to the new location.

Table 5-5
Replacement Value of the Current Economic Infrastructure, by Water option (B.)

<i>Infrastructure</i>	Indio 80-40	Indio 45-40	Caño Sucio 100- 90 + Rio Indio 80- 40	Caño Sucio 100- 90 + Rio Indio 45- 40	Toabre 95-50 + Rio Indio 80-40	Toabre 95- 50 + Rio Indio 45-40	Toabre 100-90+ Caño Sucio 100-90 + Rio Indio 80-40	Toabre 100-90+ Caño Sucio 100-90 + Rio Indio 45-40
Roads								
Permanent	90,000	0	90,000	0	90,000	0	90,000	0
Summer	376,000	174,000	376,000	174,000	376,000	174,000	376,000	174,000
Dirt	143,600	81,600	190,000	128,000	254,400	192,400	354,000	292,000
Facilities								
Telephone antennae	15,000	10,000	15,000	10,000	30,000	25,000	35,000	30,000
Lamp post	0	0	0	0	2,000	2,000	2,000	2,000
Suspension bridges	0	14,000	6,000	20,000	0	14,000	6,000	20,000
Cement Bridge	0	0	0	0	18,000	18,000	28,000	28,000
Wooden bridge	12,000	0	12,000	0	12,000	0	12,000	0
Kiosk (Commerce)	16,000	7,000	16,000	7,000	16,000	7,000	16,000	7,000
Bus stops	0	0	0	0	6,000	6,000	7,000	7,000
Telephone booth	21,000	0	21,000	0	21,000	0	21,000	0
Storage tank	10,000	0	10,000	0	50,000	40,000	10,000	0
Total	683,600	286,600	736,000	339,000	875,400	478,400	957,000	560,000

Note: Unitary costs used for infrastructure and facilities are presented in Annex 5.

Table 5-10
Overall EMP Estimate for the Water options at the Indio, Caño Sucio and Toabre River Watersheds

	Options							
	1	2	5	6	7	8	9	10
Duration of Construction Stage (years)	5	3	5	3	5	3	5	5
A. Mitigation, Monitoring and Verification and Control								
Resettlement and Human Development	18414574	10620217	23,070,401	14,139,884	25,056,177	17,783,460	35,814,192	27,157,035
Air Quality and Noise	S/C	S/C	S/C	S/C	S/C	S/C	S/C	S/C
Seismology and Geology	S/C	S/C	S/C	S/C	S/C	S/C	S/C	S/C
Erosion and Sediment Transport	4,750,000	2,850,000	5,700,000	4,750,000	6,650,000	5,700,000	6,650,000	5,700,000
Water Quality	450,000	290,000	530,000	450,000	610,000	530,000	610,000	530,000
Recovery of Terrestrial Biodiversity	996,960	370,800	1,221,120	594,960	1,080,000	453,840	1,342,080	715,920
Aquatic Plants	115,372	88,748	177,496	177,496	177,496	226,244	226,244	266,244
Fish Macro-Invertebrates	149,740	115,185	230,370	230,370	230,370	230,370	345,555	345,555
Archaeological Sites	1,300,000	780,000	1,560,000	1,300,000	1,820,000	1,560,000	1,820,000	1,560,000
Other Programs	S/C	S/C	S/C	S/C	S/C	S/C	S/C	S/C
SUB - TOTAL	26176646	15114950	32,489,387	21,642,710	35,624,343	26,483,914	46,808,071	36,274,754
B. Compensation for Land Use Change								
Forest	5,740,035	2,708,385	6,268,835	3,237,185	8,557,810	5,526,160	10,046,610	7,014,960
Grassland	969,230	509,730	1,176,431	716,931	1,590,012.50	1,130,512.50	2,080,023	1,620,524
Shrubland	1,642,300	868,300	1,941,416	1,167,416	2,821,617	2,047,617	3,577,734	2,803,734
SUB - TOTAL	8,351,565.0	4,086,415.0	9,386,682.0	5,121,532.0	12,969,439.5	8,704,289.5	15,704,367.0	11,439,217.5
GRAND TOTAL	34,528,211	19,201,365	41,876,069	26,764,242	48,593,783	35,188,204	62,512,438	47,713,972

Table 5-11
Total Costs for the Resettlement and Human Development Plan

Rio Indio, Caño Sucio and Toabre River Watersheds	Indio 80-40	Indio 45-40	Caño Sucio 100-90 + Rio Indio 80-40	Caño Sucio 100-90 + Rio Indio 45-40	Toabre 95-50 + Rio Indio 80-40	Toabre 95-50 + Rio Indio 45-40	Toabre 100-90+ Caño Sucio 100-90 + Rio Indio 80-40	Toabre 100-90+ Caño Sucio 100-90 + Río Indio 45-40
Families Displacement	5,165,000	3,128,000	6,988,000	4,951,000	7,448,000	5,411,000	10,885,000	8,848,000
Loss of production	696,267	416,961	963,584	684,278	1,021,310	742,004	1,492,445	1,213,139
Replacement Lanas	7,474,587	3,380,196	9,987,697	4,757,146	10,453,987	6,881,236	17,178,657	12,221,466
Infrastructure and social cohesión	1,495,120	508,460	1,495,120	508,460	2,357,480	1,370,820	2,401,090	1,414,430
Economic Infrastructure	683,600	286,600	736,000	339,000	875,400	478,400	957,000	560,000
Additional Infrastructure	500,000	500,000	500,000	500,000	500,000	500,000	500,000	500,000
Single Window	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000	1,000,000
Monitoring	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000	1,200,000
Verification and control	200,000	200,000	200,000	200,000	200,000	200,000	200,000	200,000
Total	18,414,574	10620217	23,070,401	14,139,884	25,056,177	17,783,460	35,814,192	27,157,035

ANNEX 7-A

**Report on the Workshops for Consultation on the Scope and Methodology for the
Environmental Evaluation of the Water Options in the Indio, Caño Sucio and Toabré
Rivers in the Western Region of the Panama Canal Basin**

November 12 and 13, 2003, Room 315 of the Ascanio Arosemena Center

November 26, 2003

Table of Contents

1.0	Introduction.....	2
2.0	Description of the Consultations	2
2.1	Workshop Participants	3
2.2	Summary of Workshop	3
3.0	Comments from Participants.....	4
3.1	Comments Relating to Possible Socio-Environmental Impacts	4
3.2	Commentary Regarding Preventive Measures, Mitigation and Compensation	6
4.0	Conclusion and Workshop Recommendations	7

1.0 Introduction

URS Holdings, Inc. (URS) was selected by the Panama Canal Authority (ACP) for the environmental analysis of water options in the Western Panama Canal Basin. The selection and signing of URS was a competitive process (Request of Offer # SAA-158332), under the negotiated offer for best value scheme. More specifically, under this contract URS will conduct the environmental analysis of the water resources in the rivers Indio, Caño Sucio and Toabré, previously identified by the ACP.

In accordance with the terms of reference, the work plan of this consultancy includes a presentation of the scopes and methodology for the environmental identification and evaluation of the possible impacts on representative entities of the different sectors of the country, including agencies of the the public administration of the Government of Panama, as well as representatives of Civil Society. This document has been prepared with the purpose summarizing what took place during the consultation process.

The document has four sections including this introduction. Section two describes the activities developed during the consultation workshops and the organizations that participated. Section three describes the commentaries and contributions made by participants in these consultation events and section four presents the conclusions and recommendations made at the end of the consultation. Also included is an annex of the presentations made by the ACP and URS and the identification and impact evaluation mythology** document as prepared by the URS prior to the consultation.

2.0 Description of Consultations

The consultations were held during two consecutive days, November 12 and 13 of 2003, in room 315 of the Ascanio Arosemena Learning Center, which is part of the ACP facilities in building 704 in Balboa. Both events started at approximately 8:30 AM and lasted until 1:00 PM. The objectives of these events were the following:

1. To present the results of recently concluded studies on the socioeconomic and environmental characterization of the ROCC that describe existing conditions in the area of study
2. To present the characteristics of the water options contemplated for the rivers Indio, Caño Sucio and Toabré;
3. To present the scopes and methodologies proposed for the environmental evaluation of the water options in the Indio, Caño Sucio and Toabré river basins; and

4. To hear comments from participants about those scopes and methodologies that will enrich the process of environmental evaluation for the mentioned options.

2.1 Workshop Participants

Workshop participants were institutions such as the national environment authority (ANAM), the ministry of housing (MIVI), the ministry of agricultural development (MIDA), Caritas Arquidiocesana, the NGO TECNOSERVE, and the Natura Foundation. Also present were representatives of the ACP and specialists from the URS. A complete list of participants is annexed to this document.

2.2 Summary of Workshop

The workshop program began with a presentation by the ACP thanking participants and asking for their active participation in the consultation process, which is highly valued by the ACP. After the introduction came a brief description of the workshop objectives and an opportunity for the participants to introduce themselves.

After the presentation all those present were allowed to make prepared presentations. In the first presentation the ACP described a brief list of the environmental studies related to the modernization of the Panama Canal that have been done or are in progress, indicating that the workshop's purpose is to present a methodology of environmental evaluation derived from one of those studies and subsequent comments about it. Finally it was established that consultation on the environmental evaluation of the water options in the western region of the Canal basin began in September and would conclude in June, 2004.

The second presentation was given by URS team members and it described the existing conditions of the ROCC. The description was based on information generated by the characterization of the biophysics and socioeconomics in the ROCC, recently carried out by consultants of the ACP, including URS.

Then the ACP proceeded to the third presentation in which the considered water options for the Indio, Caño Sucio and Toabré rivers were briefly described. Finally in the fourth presentation, members of the URS team presented the methodology for environmental evaluations for the water options in detail. As mentioned before, those presentations are included in the Annex.

The presentations were made to two institutional groups on 2 different days. The first day there was some confusion when participants thought the evaluation was ending, rather than beginning.

This was clarified and the consultation proceeded with excellent participation from the attendees.

At the end of the presentations a fruitful discussion ensued about aspects mentioned in the presentations and about suggestions made by participating guests. Comments were documented and URS provided an email address for those who wished to send additional comments and suggestions.

3.0 Comments from Participants

The participants made excellent points during and after the presentations. These observations were documented and later analyzed by the URS team, which grouped comments by subject. Comments from the MIDA representative were also received and these are detailed in the Annex.

Classification of comments by subject was organized into the following: those related to potential socio-environmental impacts and those that refer to preventive measures, mitigation and compensation from those impacts.

3.1 Comments Relating to Possible Socio-Environmental Impacts

Comments related to the characterization and possible impacts on biophysical, socioeconomic and cultural components of the ROCC and adjacent areas are listed below:

1. A more detailed evaluation of groundwaters is suggested. Also, that hydraulic regulation should be discussed in greater detail;
2. Risks associated with extreme events and contingencies should be included in the evaluation;
3. The Panamanian biological corridor and its possible fragmentation due to water options should be considered;
4. The fact that existing conditions in the region force many peasants to live and work on the sides of main rivers should be considered;
5. The precise quantity of earth to be excavated must be clearly stated and the final disposal sites and procedures;
6. The activities and actions that take place during various stages of water optimization

reflect positive effects (water provisions for the cities of Panama and Colon, and profits from ship passage through the Canal). Also, to remind others that during the drought of 1997 and 1998 water was not rationed for human consumption, but it was rationed for ship passage through the Canal, which shows that human use has a higher priority ;

7. To point out that the Canal is losing its competitive edge, and that as State policy, it must be modernized;
8. Some organizations are undermining the work done by social groups of the ACP in the region;
9. There is community resistance to dams; there is internal ideological maneuvering. Also that there are risks due to political opportunists and certain capitalists; "The latter are buying lands".
10. People in the eastern region have approached the ACP in search of the same compensation considered for the ROCC;
11. Lessons learned from recent cases in which communities have opposed hydraulic projects such as the irrigation project in Azuero be considered;
12. It is necessary to consider the possible effects of diverted waters on the marine resources of the Atlantic. Natural erosion already adds sediment to the estuaries that sustain mangroves and corals that create biodiversity and marine fauna. Fishing could be harmed and coastal economies affected. Further consultation with the Marine Authority of Panama (Doctor Franco) and the Institute for marine investigation of the University of Panama (Dr. Hansel Villaláz, Doctor Juan B. Gomez, Doctor Humberto Garcés) is suggested.
13. Besides the water options presented, the other alternatives must be studied in the event that national referendum does not approve the master plan.
14. A review of the study of hydrological regulation due to changes in plant coverage and other land uses by Doctor Ian Calder from the University of Newcastle, Director of the Centre for Land Use and Water Resources Research, is recommended

3.2 Comments Regarding Preventive Measures, Mitigation and Compensation

Comments related to strategies of prevention, mitigation and compensation for possible impacts are listed below:

1. People who are to be relocated must agree to the relocation site, as must the “receiving” or neighboring communities;
2. The development of options must be a step for communities to improve the conditions of isolation and poverty in which they live (social justice). The neighboring communities of the La Yeguada hydroelectric facility still have no electricity. Every four years before elections promises to complete the Tres Hermanas road are made but have yet to be kept;
3. Roads must not only be built to connect civil construction sites, rather they must be extended to favor surrounding communities. These communities must be taught how to maintain the roads;
4. “Improvements” or benefits derived from pending actions are perceived by families; “People have priority over the Canal”;
5. Land use regulation, like that in place for the eastern region, must be considered and proposed for the ROCC. The environmental management plan must include soil conservation;
6. Grassroots community organizations that center on economic activity and have external contacts in the region must taken into consideration;
7. Continued support must be provided for projects and efforts taking place in the area. For example, the Natura Foundation has been technically assisting in the ROCC now for three years;
8. Proposed technical assistance must serve to orient communities towards environmentally beneficial activities such as forest farming, non-traditional farming (palmito, fruit trees), new technologies and fishing, among others. Among new technologies some suggestions include pulp for paper, bioenergy and the production of wood products and crafts;
9. To formulate and develop an awareness program for peasants and dissuades them from selling their land. So far, information on the subject has been provided to peasants but

Table No 9

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Solanaceae	<i>Solanum jamaicense</i>											x	
	<i>Solanum lancaeifolium</i>											x	x
	<i>Solanum nudum</i>											x	
	<i>Solanum rudepannum</i>											x	
	<i>Witheringia asterotricha</i>											x	
Staphyleaceae											x		
	<i>Turpinia occidentalis</i>											x	
Sterculiaceae	<i>Byttneria aculeata</i>											x	
	<i>Guazuma ulmifolia</i>											x	x
	<i>Herrania purpurea</i>											x	x
	<i>Melochia melissifolia</i>											x	
	<i>Sterculia apetala</i>	Panamá								x	x	x	
	<i>Sterculia recordiana</i>											x	
Tectariaceae	<i>Ctenitis sloanei</i>			x									x
	<i>Cyclopeltis semicordata</i>										x		
	<i>Tectaria draconoptera</i>											x	
	<i>Tectaria incisa</i>											x	
	<i>Tectaria nicotianifolia</i>											x	
	<i>Tectaria pilosa</i>									x	x	x	
	<i>Tectaria rivalis</i>												
Thelypteridaceae	<i>Thelypteris hispidula</i>										x	x	
	<i>Thelypteris nicaraguensis</i>										x	x	
Theophrastaceae			x										
	<i>Clavija costaricana</i>										x		
Tiliaceae	<i>Apeiba aspera</i>	Cortezo								x	x	x	
	<i>Apeiba membranacea</i>	Cortezo									x		
	<i>Apeiba tibourbou</i>											x	
	<i>Helicocarpus americanus</i>	Majagüillo									x		
	<i>Luehea seemannii</i>										x	x	
	<i>Triumfetta lappula</i>										x	x	
Ulmaceae	<i>Trema micrantha</i>										x		

Table No 9
list of Species and of Special Interest for the Basins of the Rivers Indio, Toabre and Caño Sucio.

FAMILY	SPECIE	COMMON NAME	VU	EN	EPD	RA	CU	LR nT	CITES	DR	CS	IN	TB
Umbelliferae	<i>Hydrocotyle umbellata</i>												x
Urticaceae	<i>Boehmeria ramiflora</i>			x								x	
	<i>Myriocarpa longipes</i>											x	x
	<i>Pouzolzia obliqua</i>											x	
	<i>Urera elata</i>											x	x
Verbenaceae	<i>Aegiphila anomala</i>	Muñequillo							x		x		
	<i>Aegiphila panamensis</i>		x								x		
	<i>Cornutia grandifolia</i>										x	x	
	<i>Lantana camara</i>										x	x	
	<i>Lantana maxima</i>											x	
	<i>Lantana trifolia</i>										x		
	<i>Stachytarpheta jamaicensis</i>										x		
	<i>Vitex cooperi</i>	Cuajao		x							x		
Violaceae	<i>Hybanthus prunifolius</i>										x		
	<i>Rinorea squamata</i>	Gasparillo		x							x		
	<i>Hybanthus prunifolius</i>										x		
Vitaceae	<i>Cissus erosa</i>											x	
Vochysiaceae	<i>Vochysia ferruginea</i>	Tegle									x	x	
Winteraceae	<i>Drimys granadensis</i>										x		
Zamiaceae	<i>Zamia skinneri</i>										x		
Zingiberaceae	<i>Costus laevis</i>												x
	<i>Renealmia cernua</i>												

VU: Vulnerable; EP: Endangered; CU: Cultivated; LR nT: Lower Risk, near threatened; DR: Restrictive Distribution ;CS: Caño Sucio; IN: Indio; TB: Toabré; END: Endemic;; RA: Rare

Source: Louis Berger, 2003.

there has been no campaign to get them to agree;

10. Continue working on community awareness;
11. Rather than focusing on relocation plans, an investment plan to overcome poverty must be made;
12. If no water option is chosen, there should be a sustainable development plan for the ROCC anyway;
13. Guidelines for environmental evaluation provided by international development banks should be followed in order to qualify for funds.

4.0 Conclusion and Workshop Recommendations

The analysis of the information shared during this two-day consultation prompted worthy participation, comments and suggestions about the analysis process and environmental evaluation of the water options of the ROCC. Some key aspects derived from this consultation process are mentioned below:

1. Workshop participants had an active participation and their contributions actively helped to accomplish the workshop objectives, that is, to receive feedback about the scope and methodologies of the environmental evaluations of the water options of the ROCC and enrich them with comments and suggestions;
2. Active and relaxed participation indicates that participants felt enthusiastic and receptive towards knowing more about water options and their effects;
3. Generally speaking, participants were in agreement about the methodology of the presented environmental evaluation of water options, as indicated by an email sent by a MIDA technician. However, comments will be considered according to the needs of each case;

A written letter of thanks was sent to each participant reiterating that their suggestions will be considered and including a written report of the presentations. Follow up must be given to each delegate from each organization in such a manner that those participants return to the next activities for the advancement of this and other efforts by the ACP in the interest of a Master Plan for the Modernization of the Panama Canal.