INTERNATIONAL COURT OF JUSTICE

DISPUTE CONCERNING

CERTAIN ACTIVITIES CARRIED OUT BY NICARAGUA IN THE BORDER AREA

(COSTA RICA V. NICARAGUA)

COUNTER - MEMORIAL

OF THE REPUBLIC OF NICARAGUA

VOLUME IV

(ANNEXES FROM 112 TO 142)

06 August 2012

LIST OF ANNEXES
VOLUME IV

PHOTOGRAPHS/SATELLITE IMAGE/AERIAL IMAGE

Annex 112

UNITAR/UNOSAT
Morphological and Environmental Change Assessment
San Juan River Area (including lsla Portillos and Calero),
Costa Rica

January 2011

4 January 2011
14:00 UTC - Version 2.0
EN-20101229-CRI

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Environmental Assessment

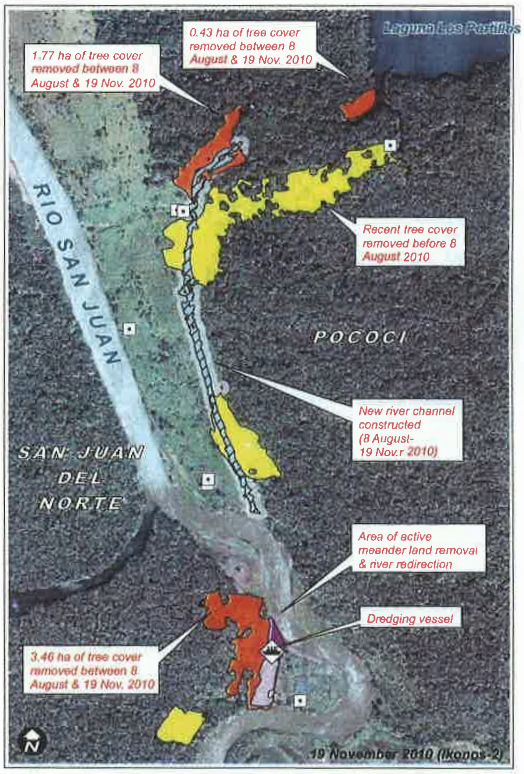
Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica

113

OVERVIEW OF ASSESSMENT AREA FOR SAN JUAN RIVER

The area has been environmentally stable over the past 30 years, with small indications of morphological change. There has been a decrease in the presence of small bodies of water; though, the general meander of the San Juan River appears stable with no dramatic changes or alterations of course.

CHANGES NEAR SAN JUAN RIVER & LAGUNA LOS PORTILLOS



Significant areas of recent tree cover removal, river dredging and new river channel creation were identified as occurring during the period from August to December 2010 between the San Juan River and Laguna Los Portillos

Legend

- Building / tent structure
- Dredging vessel
- Area of active meander land removal & river redirection (Between Nov.-Dec 2010)
- New Channel constructed August - November 2010
- Tree Cover removed (recent) before 8 August 2010
- Area of likely future meander land removal
- Tree Cover removed between 8 August - 19 November 2010

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Satellite Imagery: Ikonos and GeoEye
Resolution: 1.0m and 50cm
Imagery Dates: 8 August, 19 Nov. & 14 Dec.2010
Source: European Space Imaging
Copyright: GeoEye 2010

Hydrology Data: GEBCO, UNOSAT, NGA
Protected Data: WDPA 2010 (UNEP)
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 16N
Datum: WGS-84

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4 January 2011 -14:00 UTC - Version 2.0 - EN-20101229-CRI

Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica

By UNITAR/UNOSAT – 4 January 2011

PREFACE: This report has been produced at the request of the government of Costa Rica using commercially available satellite imagery.

ANALYSIS SUMMARY: A 30 year time series of satellite imagery dating from 1979 was reviewed for significant morphological and environmental changes in Costa Rica along the San Juan River area focusing on the areas of Isla Portillos and Isla Calero. Particular focus was made on identifying and analyzing important morphological and environmental changes since October 2010 over the area between the San Juan River and Laguna Los Portillos. Significant areas of recent tree cover removal, river dredging and new river channel creation were identified as occurring during the period from August to December 2010 between the San Juan River and Laguna Los Portillos; further there is apparently an area of active land removal on a meander bend of the San Juan River approximately 400m to the south of the newly created channel. If this meander land removal continues, it could redirect the flow of San Juan approximately 175m to the west, likely increasing river flow velocity downstream; such an increase in water velocity could also have the effect of accelerating erosion along the newly created river channel to the north. This preliminary analysis is based on a historic collection of low, medium and very high resolution satellite images recorded between 1979 and December 2010 and has not yet been validated in the field.

113

ANALYSIS SECTION 1: OVERALL REVIEW OF ASSESSMENT AREA (MAP 1)
A morphological review of the area was conducted using satellite imagery from 1979, 1986, and 2005, 2007-2010. Analysis of the stream network indicates that the area has been environmentally stable over the past 30 years, with small indications of morphological change. There has been a decrease in the presence of small bodies of water, such as small ponds, in the southern section the area of interest. Though, the general meander of the San Juan River appears stable with no dramatic changes or alterations of course.

ANALYSIS SECTION 2: CHANGES BETWEEN THE SAN JUAN RIVER AND LAGUNA LOS PORTILLOS (MAPS 2-5)
Between the San Juan River and Laguna Los Portillos, the visible extent of the San Juan River bank appears to be stable with a healthy degree of vegetation cover. There are however, indications of recent vegetation removal in the immediate area. New growth can be seen and is visibly thinner than surrounding sections. The first very high resolution satellite imagery reviewed over the area was acquired on 8 August 2010; within it there are strong signature indicators of recent tree cover removal: hundreds of fallen or cut trees are visible, as well as disturbed top soil and probable localized fire burn scars resulting from small fires used to clear remaining brush. Although it is not possible to determine with certainty the date period that such tree cover removal occurred, it is a reasonable presumption that considering the relative lack of surface vegetation cover within the area of removed trees, and its rapid growth as identified in the satellite imagery of 14 November 2010, that the trees were likely cleared within 2-4 months preceding the acquisition of the 8 August imagery, thus placing the removal during the period of May-August 2010.

Based on an analysis of satellite imagery recorded on 19 November and 14 December 2010, there is strong evidence to suggest that a new river channel leading from the San Juan River to the Los Portillos lagoon was constructed between August and November 2010. As of 8 August 2010 there were no signatures within the satellite imagery indicating the existence of an ephemeral stream to explain the appearance of this channel. There are also no apparent characteristic patterns of vegetation to suggest the presence of stream delineation as expected with an ephemeral stream activity resulting from seasonal floods. The San Juan River in fact currently remains stable with no signs of recent flooding in the area, ruling out ephemeral activity. However, there are strong indications of vegetation removal having occurred along the now existing channel path and the new entry point along the river bank. The new channel entry point along the river bank is consistent in shape and width with vegetation removal signatures identified in the satellite imagery recorded 8 August 2010. The channel course also follows the length of land where vegetation has been cleared. In addition, its course and banks are linear with a consistent width indicating artificial creation.

The new channel has increased to an average diameter of 15m, showing a 5m increase between 19 November and 14 December 2010. This increase of channel width was likely due to erosion as new water flow cuts into the soil. Removal of vegetation along the channel has helped facilitate the erosion processes as it develops. This high rate of erosion is additionally facilitated with the high velocity of water flowing in from the San Juan River. As a result the banks of the channel appear to have also increased in width from the erosion process to an average of 23m in width. It is likely that as the water cuts through the soil, the existing banks will continue to widen as sediment washes out into Los Portillos lagoon.

In the satellite imagery from 19 November and 14 December 2010 there is an apparent active attempt to redirect the San Juan River by straightening a meander approximately 400m upstream of the new river channel. In both imagery dates a large trench is clearly being cut into the meander. An apparent dredging boat is visible in both satellite image dates. From November to December 2010 the trench increased 22m in length to a total of 68m. If completed this cut in the meander will redirect the San Juan River approximately 175m to the west, and will likely significantly increase the water velocity downstream. Such a velocity increase will also increase the amount of water entering the new channel, thus likely widening the channel due to an acceleration of the erosion process resulting from the increased water velocity and inflow.

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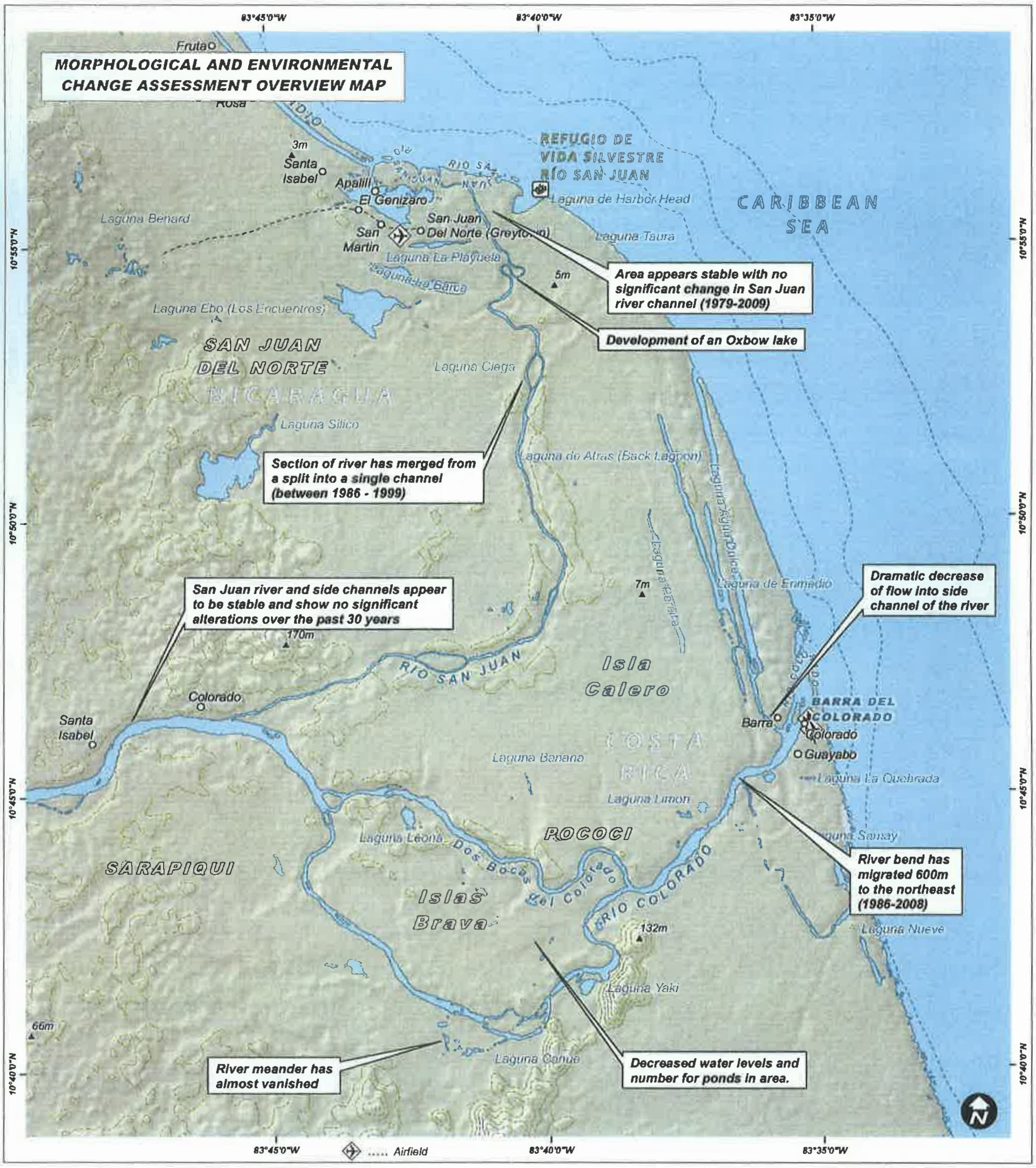

Map Scale for A4: 1:175,000

0 0.5 1 2 3 4 Kilometers

Natural Park — Track / Trail — ▲ Spot Height (meters)

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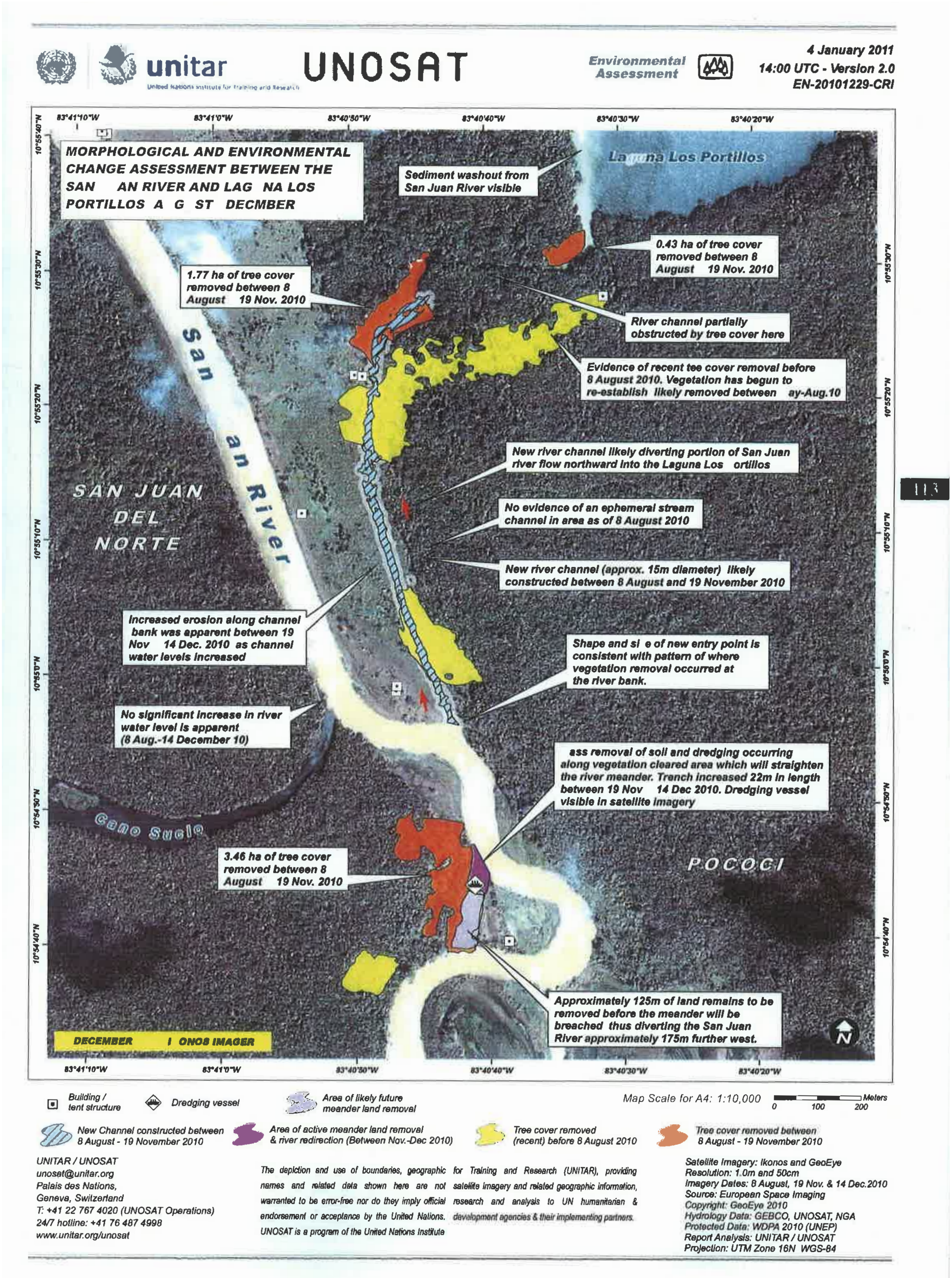
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MORPHOLOGICAL AND ENVIRONMENTAL CHANGE ASSESSMENT BETWEEN THE SAN AN RIVER AND LAG NA LOS PORTILLOS A G ST DECMBER
Sediment washout from San Juan River visible
Laguna Los Portillos
0.43 ha of tree cover removed between 8 August 19 Nov. 2010
1.77 ha of tree cover removed between 8 August 19 Nov. 2010
River channel partially obstructed by tree cover here
Evidence of recent tee cover removal before 8 August 2010. Vegetation has begun to re-establish likely removed between ay-Aug.10
San Juan River
New river channel likely diverting portion of San Juan river flow northward into the Laguna Los ortillos
SAN JUAN DEL NORTE
No evidence of an ephemeral stream channel in area as of 8 August 2010
New river channel (approx. 15m diameter) likely constructed between 8 August and 19 November 2010
Increased erosion along channel bank was apparent between 19 Nov 14 Dec. 2010 as channel water levels increased
Shape and si e of new entry point is consistent with pattern of where vegetation removal occurred at the river bank.
No significant increase in river water level is apparent (8 Aug.-14 December 10)
ass removal of soil and dredging occurring along vegetation cleared area which will straighten the river meander. Trench increased 22m in length between 19 Nov 14 Dec 2010. Dredging vessel visible in satellite imagery
Cano Suelo
3.46 ha of tree cover removed between 8 August 19 Nov. 2010
POCOCI
Approximately 125m of land remains to be removed before the meander will be breached thus diverting the San Juan River approximately 175m further west.
DECEMBER I ONOS IMAGER
N
83°41'10"W
83°41'0"W
83°40'50"W
83°40'40"W
83°40'30"W
83°40'20"W
10°55'40"N
10°55'30"N
10°55'20"N
10°55'10"N
10°55'0"N
10°54'50"N
10°54'40"N
Building / tent structure
Dredging vessel
Area of likely future meander land removal
Map Scale for A4: 1:10,000
Meters
0 100 200
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Tree cover removed (recent) before 8 August 2010
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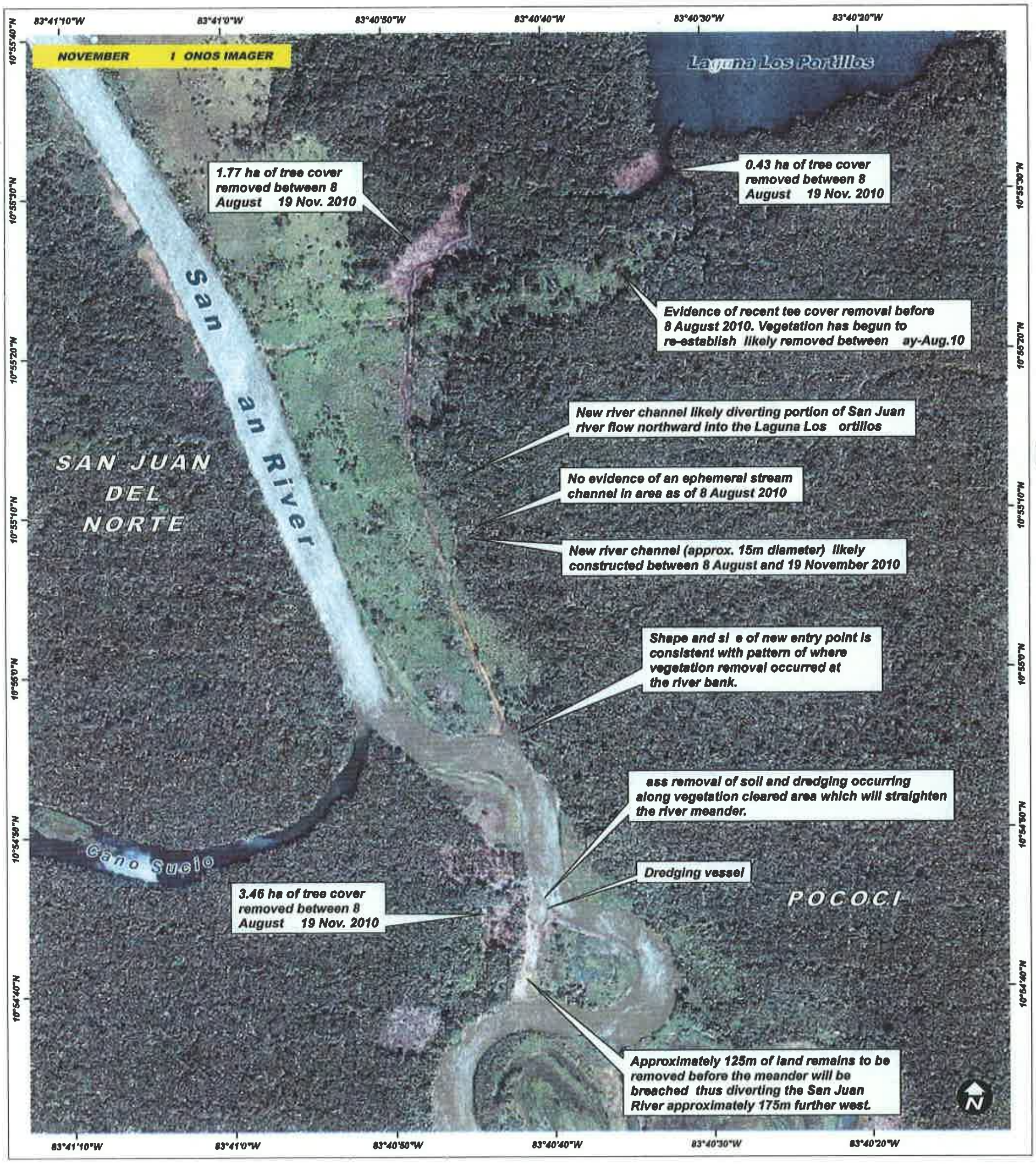

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Knowledge to lead

UNITAR/UNOSAT satellite solutions

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The UNITAR advantage

Since its establishment in 1965, UNITAR has built a unique set of expertise, experience, knowledge and capacities to design and implement a variety of research and training activities. In keeping with its mandate to "enhance the effectiveness of the United Nations in achieving the major objectives of the Organization" the Institute contributes with concrete actions to developing the capacities of Member States in the fields of economic and social development, diplomacy, and peace and security

Reaching out to beneficiaries

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UNITAR mission is to deliver innovative training and conduct research on knowledge systems to develop the capacity of beneficiaries. Building on our experience, we optimize expertise, information and knowledge-sharing to achieve this mission. The specific mission of UNOSAT is to develop applied solutions and use training to make the UN system and member states benefit from space technology in the areas of human security and humanitarian relief, disaster prevention and territorial planning, and all other relevant areas

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For information and contacts: Unosat@unitar.org or www.unitar.org/research

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Annex 113

UNITAR/UNOSAT,
"Update 1: Morphological and Environmental Change Assessment from 14 December 2010 to 24 January 2011 San Juan River Area, Costa Rica,"
available at www.rree.go.cr/file-noti.php?id_file=183

10 February 2011

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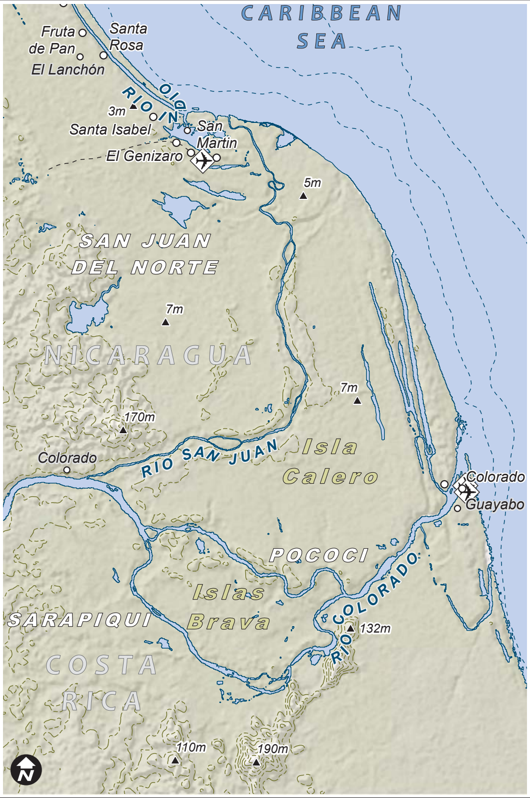
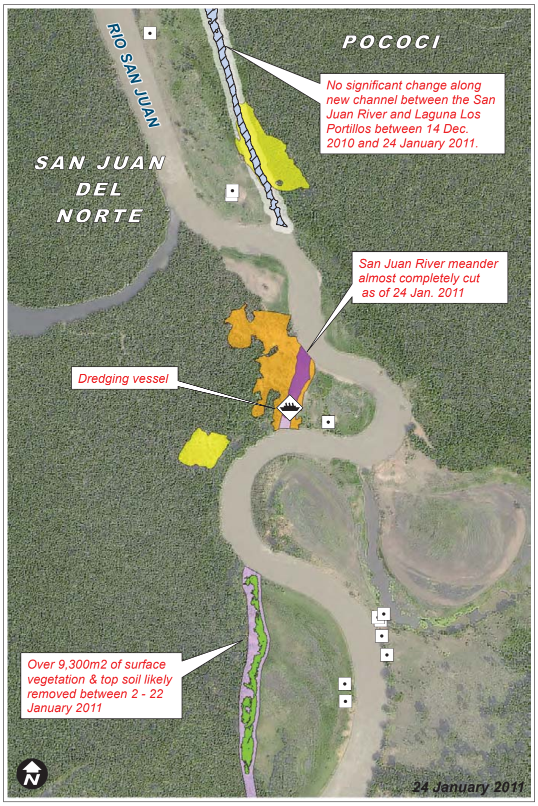
Update 1: Morphological and Environmental Change Assessment from 14 December 2010 to 24 January 2011) San Juan River Area, Costa Rica

OVERVIEW OF ASSESSMENT AREA FOR SAN JUAN RIVER



The area has been environmentally stable over the past 30 years, with small indications of morphological change. There has been a decrease in the presence of small bodies of water; though, the general meander of the San Juan River appears stable with no dramatic changes or alterations of course.

CHANGES NEAR SAN JUAN RIVER & LAGUNA LOS PORTILLOS



Significant river dredging and new channel construction continued along the San Juan River between 14 December 2010 and 24 January 2011.

Legend

- Building / tent structure
- Dredging vessel
- Area of Possible future meander land removal
- Surface vegetation and top soil removed between 2 -22 January 2011
- New Channel constructed between 8 August - 19 November 2010
- Area of active meander land removal & river redirection (Between Nov2010 & 24 January 2011)
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Satellite Imagery (1): WorldView2
Resolution: 50cm
Imagery Dates: 6 and 22 January 2011
Source: Eurimage S.p.A
Copyright: DigitalGlobe 2011
Satellite Imagery (2): GeoEye and Ikonos
Resolution: 50cm and 1.0m
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Imagery Dates (v1): 8 August, 19 Nov.14 Dec.2010
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10 February 2011 -17:00 UTC - Version 3.0 - EN-20101229-CRI

UPDATE 1 Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica

By UNITAR/UNOSAT – 10 February 2011

PREFACE: This report has been produced at the request of the government of Costa Rica using commercially available satellite imagery.

ANALYSIS SUMMARY*:* A 30 year time series of satellite imagery dating from 1979 was reviewed for significant morphological and environmental changes in Costa Rica along the San Juan River area focusing on the areas of Isla Portillos and Isla Calero. Particular focus was made on identifying and analyzing important morphological and environmental changes since October 2010 over the area between the San Juan River and Laguna Los Portillos. Significant areas of recent tree, surface vegetation cover and top soil removal, river dredging and new river channel creation were identified as occurring during the period from August 2010 to 24 January 2011 along the San Juan River, near the Laguna Los Portillos. Further, there is an area of active land removal on a meander bend (Site 1) of the San Juan River approximately 400m to the south of the newly created channel. There is an area (Site 2) with apparent vegetation and top soil removal along a second meander 360m upstream of the first meander cut. The straightening of the first river meander (Site 1) could redirect the flow of the San Juan approximately 175m to the west, likely increasing river flow velocity downstream; such an increase in water velocity could also have the effect of accelerating erosion along the newly created river channel to the north. Should clearing on the second meander (Site 2) result in a new rechanneling effort this increase of water velocity would intensify. This preliminary analysis is based on a historic collection of low, medium and very high resolution satellite images recorded between 1979 and January 2011 and has not yet been validated in the field.

REVIEW OF THE NEW CHANNEL BETWEEN THE SAN JUAN RIVER AND LAGUNA LOS PORTILLOS*:*
Erosion along the new river channel appears to have stabilized with no indication of additional structural changes between 14 December 2010 and 24 January 2011.

ANALYSIS SECTION 1: OVERALL REVIEW OF ASSESSMENT AREA (MAP 1)
A morphological review of the area was conducted using satellite imagery from 1979, 1986, and 2005, 2007-2011. Analysis of the stream network indicates that the area has been environmentally stable over the past 30 years, with small indications of morphological change. There has been a decrease in the presence of small bodies of water, such as small ponds, in the southern section the area of interest. Though, the general meander of the San Juan River appears stable with no dramatic changes or alterations of course.

ANALYSIS SECTION 2: REVIEW OF CHANGES ALONG THE SAN JUAN RIVER (MAPS 2 & 3)
A time series analysis of satellite imagery recorded between 14 December 2010 and 24 January 2011 indicated that the dredging activity identified in the first report[1] over Site 1 had removed an additional 130m of land (see table 1 for a time series breakdown). As of 24 January 2011 this cut in the river meander measured approximately 180m in total length and 40m wide, with 30m of land remaining to be cut. Given the rate of excavation it is probable that the dredging of this river meander has been completed as of 10 February 2011, thus diverting a portion of the San Juan River approximately 175m to the west.

Between 2 and 22 January 2011 there were indications of significant vegetation and top soil removal along the west bank of the San Juan River 360m upstream of the first dredging site. The clearing measures approximately 500m in length and 9,300m2 in area. The vegetation and apparent top soil removal is linear in shape and follows the course of a creek upstream 260m to where the creek turns westward after which the clearing continues further south an additional 120m. Considering the linear structure of the clearing and its proximity to the first dredging site downstream, it is possible that this will be the location for a new meander cut along the San Juan River within the next few weeks.

Imagery Date	Increase	Total Length
19 Nov. 2010	n/a	50m
14 Dec. 2010	20m	70m
02 Jan. 2011	20m	90m
22 Jan. 2011	80m	170m
24 Jan. 2011	10m	180m

Table 1: Time series measurement of San Juan River meander dredging (site 1) between 19 November 2010 and 24 January 2011.

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[1] Released on 4 January 2011

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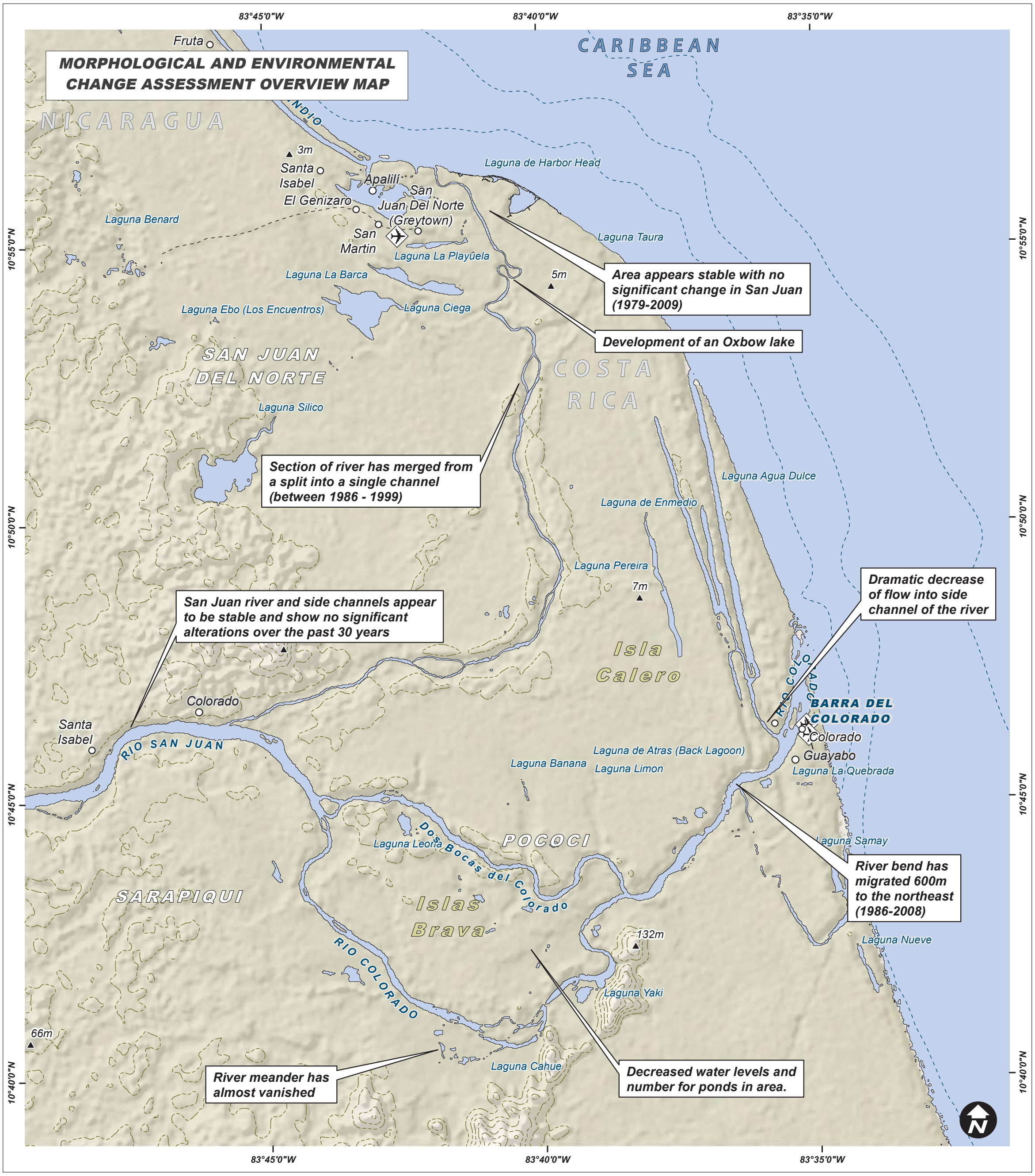

Map Scale for A4: 1:175,000

0 0.5 1 2 3 4 Kilometers

Track / Trail
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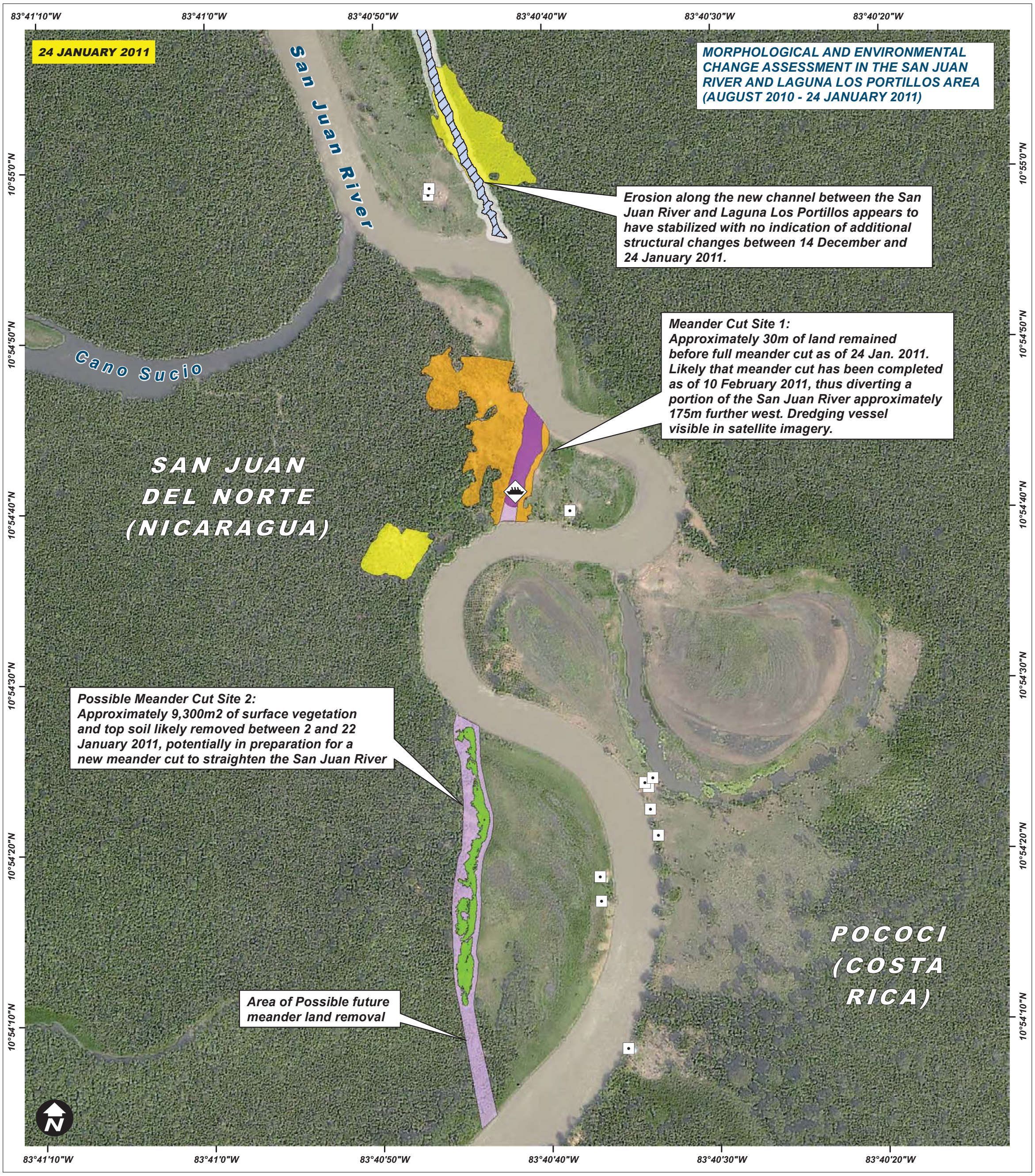

Building / tent structure

Dredging vessel

Area of Possible future meander land removal

Surface vegetation and top soil removed between 2 -22 January 2011

New Channel constructed between 8 August - 19 November 2010

Area of active meander land removal & river redirection (Between Nov2010 & 24 January 2011)

Tree cover removed (recent) before 8 August 2010

Tree cover removed between 8 August - 19 November 2010

Map Scale for A4: 1:9,500 — 50 25 0 50 100 150 200 Meters

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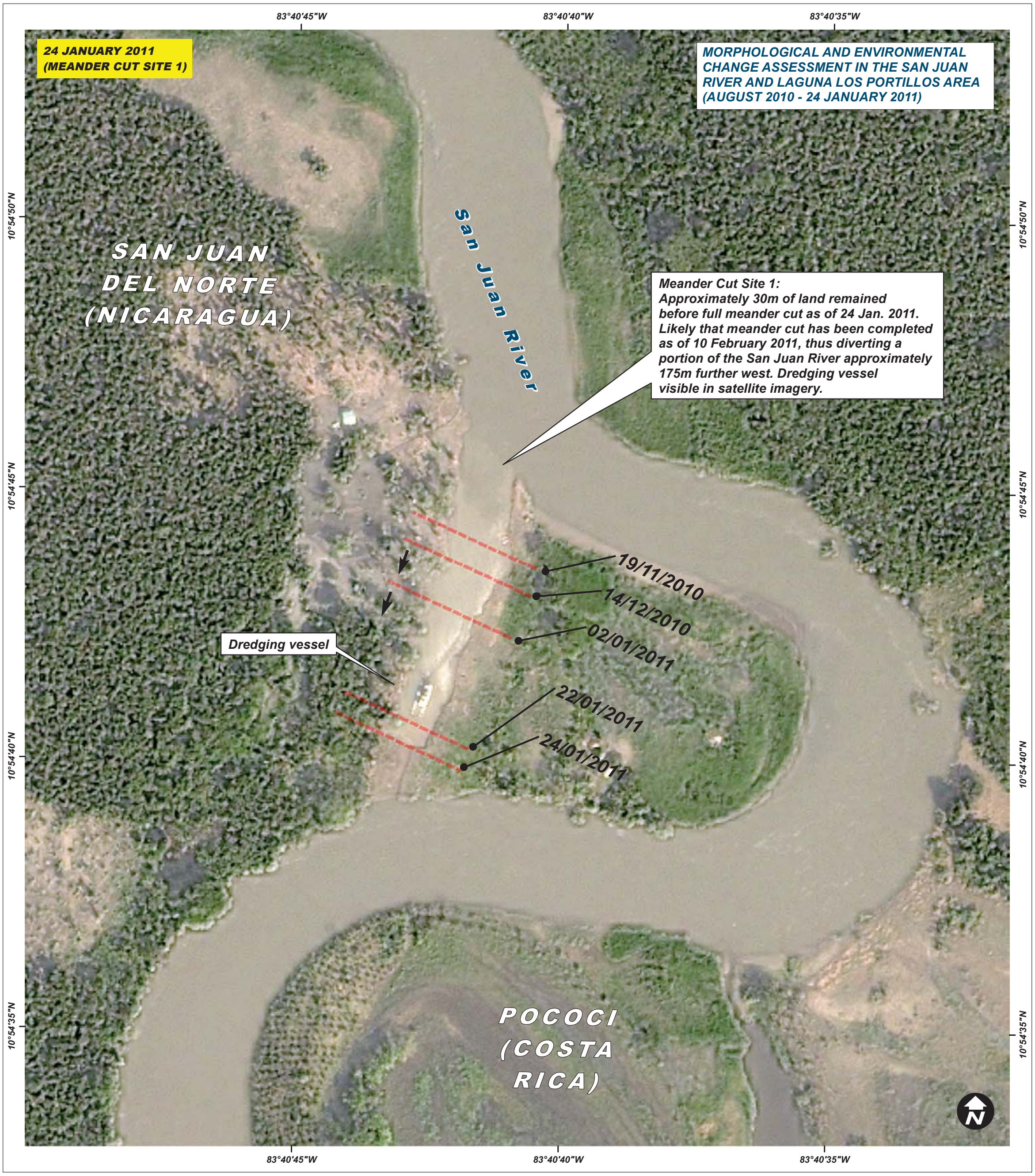

Legend

Limit of Meander Dredging by Date

Map Scale for A4: 1:3,000 — 50 25 0 50 Meters

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Satellite Imagery (1): WorldView2
Resolution: 50cm
Imagery Dates: 6 & 22 Jan. 2011
Source: Eurimage S.p.A
Copyright: DigitalGlobe 2011
Satellite Imagery (2): GeoEye, Ikonos
Resolution: 50cm and 1.0m
Imagery Dates (v2): 2 & 24 Jan.2011
Imagery Dates (v1): 8 August, 19 Nov.14 Dec.2010
Source: European Space Imaging
Copyright: GeoEye 2010
Hydrology Data: UNOSAT, NGA
Protected Data: WDPA 2010 (UNEP)
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 17N
Datum: WGS-84

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Annex 114

Van Rhee & De Vriend, Delft University of Technology,
"Morphological Stability of the San Juan River delta, Nicaragua / Costa Rica,"

4 January 2011

Morphological Stability of the San Juan River delta, Nicaragua / Costa Rica

DELFT UNIVERSITY OF TECHNOLOGY

Authors:
Prof. Dr. ir. C. VAN RHEE
Prof. Dr. H.J. de Vriend

INTERNAL REPORT January 4, 2011

Contents

Executive Summary

As Professors at Delft University of Technology with expertise in dredging and the environmental consequences of dredging, we have been requested on behalf of the Republic of Nicaragua to assess the potential physical and environmental impacts of its proposed dredging of the San Juan River, which is the subject of a dispute with Costa Rica that is pending before the International Court of Justice. We determined that the dredging project, as approved by the Nicaraguan environmental agency, *Ministerio del Ambiente y los Recursos Naturales* (MARENA), would increase the flow of the San Juan River by the modest amount of approximately 20 cubic meters per second and would not decrease the flow of the San Juan River to the branch of the Colorado significantly when flow in the San Juan River is at its lowest and would have only a negligible impact during the season when flow is at its highest (the order of magnitude of the discharge of the Colorado is 1400 - 1700 m^3/s) . We also determined that the now completed manual clearing of the caño that connects the San Juan River to the Harbor Head Lagoon (Harbor Head Caño) caused no significant increase in flow through that caño given how small the flow rate is.

In our view, the conclusions in Nicaragua's Environmental Impact Study are sound. The small increases in flows through the San Juan River and the Harbor Head Caño would cause no permanent environmental impacts. Nor would the deposition of sediments from the dredging project cause any permanent environmental impacts given that those sediments would be located on the Nicaraguan side of the San Juan River at least 50 feet from the river bank within specially designed barriers. While the dredging may cause a small increase in the amount of suspended solids in the San Juan River and in the Harbor Head Caño, that increase will not cause any measurable environmental harm given the small increase in concentration in relation to the already high natural turbidity of the river. Additionally, as is customary in a project like this one, mitigation measures will be implemented to address the felling of any trees with the prompt replanting of new trees of like species.

Moreover, the dredging project described in the EIS has since been reduced in scope, as explained in the Declaration of Mr. Quintero Gomez. As such, even the small impact of the dredging project on the environment and on the branch of the Colorado will likely be reduced.

In sum, Nicaragua's proposed dredging project is of small scale. It will produce only minor increases in flow during the dry season and will cause no permanent environmental impacts. Any temporary impacts caused by

the dredging will be insignificant and readily mitigated through the environmental management plan approved by MARENA.

Chapter 1

Introduction

On the 18th of November 2010, Costa Rica initiated a case against the Republic of Nicaragua at the International Court of Justice related to the dredging of the San Juan River, as well as the manual cleaning of the caño that connects the San Juan River to the Harbor Head Lagoon (Harbor Head Caño), which has already been completed. As described in Nicaragua's Environmental Impact Study:

> The project consists of dredging critical points along 42.0 kilometers of the riverbed of the San Juan River of Nicaragua that make navigation difficult for ships transporting freight and passengers, and that impedes the flow of tourist movement. This dredging activity will be performed by extracting material that basically consists of sand, creating a channel that is 2.0 meters deep, 30 meters wide at the upper section, and 20 meters wide at the lower section. The debris that is removed will be deposited at sites that have already been selected. It will be shaped and flattened to a height of no more than one meter. These sites will be restored and replanted with species native to the humid tropics of Nicaragua.

According to MARENA, the dredging project was expanded to include the manual cleaning of the Harbor Head Caño ¨ to include the removal with hand-held tools of the accumulated debris and overgrown vegetation that were impeding normal navigation ¨ (Espinoza Urbina (2010)), at para. 22).

In this report the following issues will be investigated:

- *Whether it is reasonable to conclude that the dredging project will decrease the flow of the Colorado River by less than 5%*;
- *Whether it is reasonable to conclude that that the dredging project will cause only a small increase in flow through the San Juan River and the Harbor Head Caño, and*

- *Whether it is reasonable to conclude that the increase in flow through the San Juan River and Harbor Head Caño will not cause any permanent environmental impacts and that any temporary impacts will not be significant and can be properly addressed through customary mitigation measures.*

In connection with this report, we have reviewed data related to Nicaragua's proposed dredging and completed caño-clearing project contained in Nicaragua's Environmental Impact Study and supporting documentation, as well as various affidavits by Nicaraguan officials, as set forth in the Bibliography to this Report (Vivas Soto, 2010; Silva Munguía, 2010; Quintero Gómez, 2010a,b).

As set forth more fully in our resumes attached to this report, Dr. ir. C. van Rhee is currently a full Professor of Dredging Engineering at Delft University of Technology in Delft, the Netherlands. He has published extensively on a wide range of issues related to dredging and has been engaged since 1984 in fundamental research for the dredging industry. Most of the dredging projects on which Professor van Rhee has worked are of a significantly larger size than the one proposed by Nicaragua. Professor Dr. H.J. de Vriend, is the Chairman of River and Estuarine Engineering at Delft University of Technology. Professor de Vriend is an expert in the environmental impacts of river dredging.

1.1 Background

In connection with the proposed dredging project, a 255-page Environmental Impact Study (¨EIS¨) and voluminous annexes of supporting technical information was prepared for review by MARENA. That EIS provided a technical description of the proposed dredging along each segment of the 42 kilometer portion of the San Juan River, together with descriptions of water flows, soil types, and water quality in each of the segments. The EIS also provided descriptions of the flora and fauna in the area of the San Juan River. Finally, the EIS provided an analysis of potential environmental impacts from the dredging project as well as an Environmental Management Plan designed to mitigate any impacts.

As the EIS explained, the dredging project would begin at the Delta of the San Juan River which is situated at the border between Nicaragua and Costa Rica. Here the river splits into two main branches, one of which - called San Juan River - continues largely to the north and debouches into the Caribbean in Nicaragua, whereas the other one - called Colorado River - goes largely west and debouches into the Caribbean in Costa Rica. The Colorado River takes most of the discharge, but both rivers are important to navigation. It was the conclusion of the EIS that the dredging project would decrease the flow of the Colorado River, which is currently 1,700 cubic meters per second or less, by less than 5 %.

After the EIS was prepared and the dredging project approved by MARENA, a proposal was made to include the clearing by hand of vegetation and debris from the 1,560 meter length of the Harbor Head Caño to a width of 30 meters. Information was submitted to the MARENA showing that the Caño, which had existed for many years, had gradually become difficult to navigate because of the accumulation of sediment and organic debris. After approval was given by MARENA, the proposed work in the Caño was completed in November of 2010. In December, 2010, the flow of water in the Caño was measured at 2.38 cubic meters per second.

The proposed San Juan dredging project is of a very small scale compared to dredging projects carried out by the large Dutch dredging contractors currently working globally with hourly productions of more than 10,000 m^3/hour and dredging depths between 20 - 50 m. Estimated dredging production in the San Juan is of the order of 400 m^3/hour with dredging depths of only 2 m.

Chapter 2

The effect of dredging on the discharge of San Juan river

In the EIS, it was calculated that the proposed dredging project decrease the flow of the Colorado river by less than 5%. In the Request for the Indication of Provisional Measures for the International Court of Justice, however, it is mentioned that dredging of the San Juan River will cause a diversion of 1,700 m3/s from the Colorado to the San Juan River. In this chapter, it is explained that the EIS conclusion was correct and that, conservatively estimated, the proposed dredging project is likely to decrease no more than 20 cubic meters per second of the flow in the Colorado River (which is of the order of 1400 - 1700 m^3/s).

2.1 Flow distribution without morphological change

2.1.1 Computation of discharge

The flow distribution between the Colorado and San Juan river will depend on the difference in flow resistance between the two rivers. The discharge in a river is the product of the average flow velocity V and the (cross-sectional) area of the flow A:

$$Q = V \cdot A \tag{2.1}$$

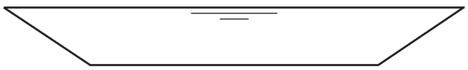
The average flow velocity in a river is determined using Chezy's Equation (Fox and McDonald, 1994):

$$V = \frac{R_h^{\frac{2}{3}} S^{\frac{1}{2}}}{n} \tag{2.2}$$

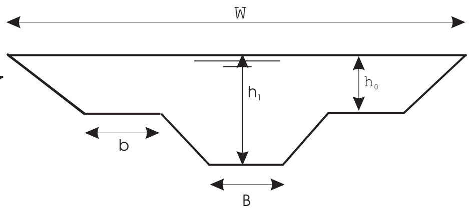
Where R_h = the hydraulic radius, S = slope of the river in flow direction and n = Manning Roughnes Coefficient. The hydraulic radius is the ratio between the area of the flow and the wetted perimeter

$$R_h = \frac{A}{O}$$

The cross sectional Area A depends on the shape of the cross section of the river (for instance rectangular). Figure 2.1 shows two different river cross sections. Figure 2.1a shows the original river profile (simplified) while figure 2.1b shows the flow area after dredging. Over a bottom width B the river is deepened. When A_n and O_n are the flow area and perimeter of the new profile these values can be computed as follows:



(a) orig. cross section



(b) section after dredging

Figure 2.1: Flow area before and after dredging.

$$A_n = s_1 h_0^2 + 2bh_0 + s_2(h_1 - h_2)^2 + 2s_2(h_1 - h_0)h_0 + Bh_1 \tag{2.3}$$

Where the slope s is defined as the ratio between the horizontal and vertical distance of an inclination (hence $tan^{-1}\alpha$). The wetted Perimeter O_n reads:

$$O_n = 2\sqrt{h_0^2(1 + s_1^2)} + 2\sqrt{(h_1 - h_0)^2(1 + s_2^2)} + B + 2b \tag{2.4}$$

Where b equals :

$$b = \frac{1}{2}(W - B) - s_1 h_0 - s_2(h_1 - h_0)$$

2.2 Computation of discharge in San Juan River

2.2.1 Present situation

Figure 2.2 shows flow measurements from the San Juan river. The cross-sectional flow area is 182 m^2 and the average flow velocity is 0.98 m/s, which leads to a discharge of 178 m^3/s. The average depth of the flow is 2.19 m. Table 2.1 shows that the slope of the river varies between $1.2 \cdot 10^{-4}$ and

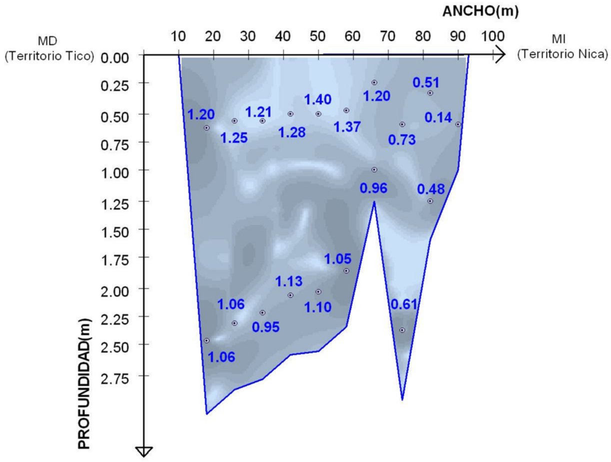


Figure 2.2: Flow velocity measurements in San Juan river.

$2.8 \cdot 10^{-4}$.

In table 2.1 the theory presented above is applied on the values of the San Juan river. The computed values are close to the measured ones when a value for Manning's coefficient $n = 0.025$ is used. This is a reasonable value for a river.

Table 2.1: Typical values for the San Juan river

Width of the river	100	[m]
Depth before dredging	2.19	[m]
Slope of river	$2 \cdot 10^{-4}$	[-]
Manning Coefficient	0.025	[-]
Average flow velocity	0.91	[m/s]
Discharge river (before Dredging)	185	[m^3/s]

2.2.2 Influence of deepening

The goal of the dredging plans is to obtain a navigable depth of 2 m over a bottom width of 20 m. In the profile of figure 2.2 this depth is already present. For lower values of the river discharge or on locations where the width exceeds the value shown in table 2.1 the average water depth will be lower than needed for navigation. The river will flow in a wide bed with a shallow water depth. Local deepening of the river will concentrate the flow over a smaller width which leads to improved possibilities for navigation. It will be investigated what the influence of the deepening is on the river discharge for varying values of the water depth. The river discharge is calculated as a function of the value of h_0, keeping h_1 at a constant value of 2 m. So when the value of h_0 approaches to zero the river only flows through the deepened section. For a value of h_0 equal to 2 m the river is not deepened and depth is uniform over the total width (more in line with figure 2.2). Figure 2.3 shows the resulting discharge and flow area as a function of the water depth h_0.

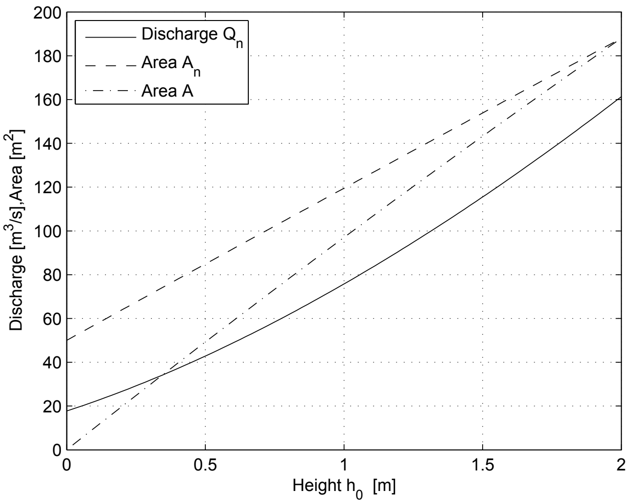


Figure 2.3: Flow area and discharge as a function of the water depth.

The figure shows three lines. The dotted lines indicate the value of the cross section of the flow. Area A is the flow area for the original situation (figure 2.1a, no deepening). For the line A and the situation $h_0 = 0$ the river bed is dry, no flow. When $h_0 = 0$ for the deepened situation (A_n), the plains beside the channel are dry and the flow is concentrated in the channel. For $h_0 = 2m$, $h_1 = 0$ and no deepening is needed and both area's are equal. The continuous line gives the discharge for the area A_n. For $h_0 = 0$, discharge is approx. 20 m^3/s indicating the situation where the river only flows through the channel. This value is therefore in theory the minimum value needed to ensure navigation during a low-discharge period. This value is very low compared with the discharge in the Colorado river.

Figure 2.3 shows a situation where the water depth in the channel is equal to 2 m for different values of h_0. For example when the water level h_0 equals 0.75 m, the depth of the excavation in the river bed must be 1.25 m to get a water level h_1 in the channel equal to the desired 2 m. To ensure navigation at low values of the river discharge the excavated depth must be 2.0 m on most locations. To investigate the influence of the discharge in the San Juan river it is therefore more realistic to base the calculations on a dredged depth of 2.0 m in the original river bed. The same equations apply, but now the value of $h_1 = 2.0 + h_0$, the water depth in the channel equals 2.0 m plus the water level on the plains beside the channel. Figure 2.4 shows he result

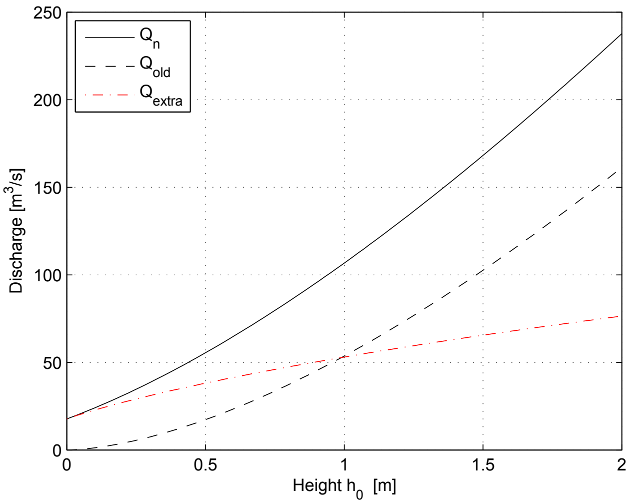


Figure 2.4: Discharge as a function of the water depth.

of this approach. In the graph three lines are shown. The discharge in the original situation Q_{old}, the dredged situation Q_n and the difference between these two values Q_{extra}. For a low discharge the river only flows through the channel and the extra discharge is the already mentioned 20 m^3/s. For an average value of the discharge ($h_0 = 1m$) the extra discharge is 50 m^3/s. Compared with the Colorado discharge of 1700 m^3/s this is only 3 % extra. Note that the value of 20 m^3/s (for low river discharge) is a conservative value which will be lower in reality because this value is compared with a situation where $Q_{old} = 0$ m$^3/s$, a completely dry San Juan river.

Chapter 3

Environmental impact of the dredging project

In our view, the small increases in flows through the San Juan River and the Harbor Head Caño are unlikely to cause permanent environmental impacts. In light of the relatively modest scale of the project, the EIS identified and evaluated potential environmental risks consistent with current international practice. The San Juan River and Colorado River is a bifurcated river system which has shown itself to be stable over many decades. The sediment dredged from the San Juan River, which will result in a slight increase in flow only in the low water season, constitutes the type of small perturbation which is unlikely to cause a permanent environmental impact in a stable bifurcated river system.

Similarly, assuming the large-scale geometry of the delta system remains unaltered, there would seem to be little reason to believe that any permanent environmental impact would result from the Caño clearing work. The small scale of that work is indicated by the fact that it was performed by hand with shovels and buckets. Additionally, the Caño has remained stable through many years and flood cycles. There will be only a small increase of flow in the San Juan River resulting from the dredging work, and the manual clearing of debris and vegetation with shovels is unlikely in this circumstance to produce the type of dramatic increase in the flow in the Caño that might cause a permanent impact. Indeed, after the Caño clearing work was completed, the flow in the Caño was measured at only 2.38 cubic meters per second, which means the water is barely moving at all.

Moreover, the dredging project and Caño clearing, as approved by MARENA, incorporate an additional layer of protection against environmental impacts in the form of mitigation measures. For example the Environmental Management Plans adopted for the dredging and Caño clearing project require that any sediments dredged from the San Juan River be deposited in specially designed barriers on the Nicaraguan side of the river at least 50 feet from the river. Likewise any trees felled during the work must be replaced tenfold by trees of similar species.

While the dredging may cause a small increase in the amount of suspended solids in the San Juan River and in the Harbor Head Caño, that dredging is not likely to cause any measurable environmental harm given the pre-existing high natural turbidity of the river. As evidenced by photographs of the San Juan River taken prior to the commencement of the dredging project, the water in the San Juan River is brownish, as is often true for rivers in tropical areas, which naturally contain significant amounts of organic material. The small and temporary increase in the concentration of suspended solids that will result from the dredging will not have any significant impact given the naturally-occurring concentrations of organic material in the San Juan River and the Harbor Head Caño.

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Annex 115

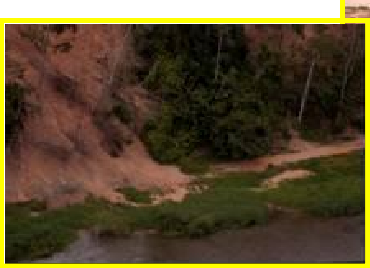
FUNDENIC SOS & FONARE, Technical Report “Evaluation of the environmental impacts caused by the construction of a 120 km long road parallel to the right bank of the San Juan de Nicaragua River”

March 2012

FUNDENIC-SOS

FONARE
Alerta Ambiental

TECHNICAL REPORT
Evaluation of the environmental impacts caused by the construction of a 120 km long road parallel to the right bank of the San Juan de Nicaragua River



March 2012

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Technical Report
Environmental Impact Assessment on "Construction of *120 km road on the San Juan de Nicaragua River's right bank*"

1 INTRODUCTION

In February 2011, following the enactment of an emergency decree, the Government of Costa Rica started building a road with an estimated 160-km length running from Los Chiles, Province of San Carlos, to Delta Costa Rica at the mouth of the Colorado River in the Province of Heredia, at a cost of 10 million colones. Starting at milestone N° 2 on the Nicaragua-Costa Rica border, the road stretches along 120 km about 5-20 meters from the San Juan River's right bank.

In view of this situation, two non-governmental organizations—the Nicaraguan Sustainable Development Foundation (FUNDENIC SOS) and National Recycling Forum (FONARE)—filed a complaint in November 2011 with the Central American Court of Justice against the Government of Costa Rica. As part of the complaint, evidence had to be produced to support the negative impacts being caused by the road construction and the inferred potential impacts expected at the operational stage.

This technical report describes its development process. A technical team of experts was formed that visited the San Juan River on different occasions by water and air. Audiovisual information was gathered on these trips and on-site inspections were made, when feasible. Technical information concerning the environmental impacts of the road construction and preventive actions were gathered and reviewed at the desk level.

The characteristics of watershed N° 69 are described, emphasizing its regional and local importance on account of natural and social values found in the San Juan River subbasin. This area is a terrestrial and aquatic biodiversity bridge between the northern and southern parts of Middle America. Problems arising from the water erosion, sedimentation and pollution process in the San Juan River are also described on the basis of the Costa Rica-Nicaragua bi-national project studies carried out in 1994-2004.

The road description is based on information provided by Costa Rican government officials in their different statements to the media and available in both printed and digital Costa Rican and Nicaraguan newspapers, as well as information gathered by experts during field trips.

The impact identification and assessment process is described, first at the field level and then at the office level, where the area of influence of the road was defined in meetings with experts, and a checklist of physical, biological, and socioeconomic environmental impacts was developed for road construction and operational stages. Impacts were assessed through negative impact relevance matrices. In both cases, experts from various disciplines "unanimously assessed environmental impacts caused by road construction as severe."

Finally, conclusions and recommendations are presented, including proposed guidelines for both countries to jointly work on the search for solutions to this border dispute.

This report was developed by the following experts: Dr. Jaime Incer Barquero; Dr. José Antonio Milán Pérez; Raquel Chavarría, MSc; Fabio Buitrago, MSc; Jacinto Cedeño, BS; Dr. Ricardo Rueda; Augusto Flores, MSc; Dr. Jorge Gallo; Milton G. Camacho Bonilla, BS; José Manuel Zolotoff, MSc; Dr. Salvador Montenegro; Edgar Castañeda, MSc; and Kamilo Lara, MSc.

2 OBJECTIVE OF TECHNICAL REPORT

Document, identify, analyze and assess actual and potential negative environmental impacts and their consequences, as well as identify potential hazards related to the "construction of a 120-km road along the San Juan de Nicaragua River's right bank," a project developed within the territory of the Republic of Costa Rican for submittal to the Central American Court of Justice.

3 METHODOLOGY USED IN THE ENVIRONMENTAL ASSESSMENT

This environmental impact assessment was carried out in two parts: a field assessment and a desk assessment. In order to identify and assess environmental impacts, a combination of methods was used.

3.1 Impact Identification

The following methods were used in identifying environmental impacts:

1. **Field visits**: To observe, study, record, and check impacts from road construction, including inspections on the river and flights along the right banks of the San Juan River.

2. **Checklist to identify project actions most heavily impacting environmental variables and ecosystems**: Actions affecting the environment and the population were determined through this technique, and damages on the ecology and economy of the impacted area were defined.

3. **Bibliographical review**: An evaluation and analysis of other documents was performed based on similar experiences to define potential impacts and quantify specific changes in area ecosystems. Documents prepared by independent professionals and consultants were also reviewed. These documents are listed below, while the rest of the supporting bibliography is listed at the end of this report.

    1. Informe de evaluación de la construcción de la carretera que construye Costa Rica paralelo a la frontera con Nicaragua. Fidel Rodríguez, BS, and Mayra Blandino L., MSc, experts in road engineering and the environment, December 20, 2011.

    2. Caracterización geológica ambiental carretera orilla del margen sur del río San Juan de Nicaragua. Dr. William Martínez Bermúdez, expert geologist, and Carlos Laínez Granados, BS, expert hydrologist, January 2012.

    3. Informe sobre los impactos ecológicos que ocasiona la carretera que se construye paralelo al río San Juan. Fabio Buitrago, MSc, expert in ecology.

    4. Article titled Incumplimiento por parte de Costa Rica, al "Manual Centroamericano de Normas Ambientales para el Diseño, Construcción y Mantenimiento de Carreteras." Published by El Nuevo Diario. Mayra Blandino, February, 2012.

4. **Expert opinion**: Obtained through direct interviews, meetings, and a relevance matrix analysis and evaluation. Experts have proven experience in and knowledge of the affected area. This work stage enabled identifying the high environmental vulnerability of the San Juan River area, and how many past actions are altering the ecosystem. This was possible through a bibliography review of studies carried out in previous years by multidisciplinary teams from both countries, such as *Diagnóstico de la cuenca del Río San Juan y Lineamientos del Plan de Acción* (PROCUENCA, 2004) and other bibliographies produced in Costa Rica, as well as reports on the State of the Nation, Universidad de

Costa Rica's School of Geography master's degree thesis, and others. At this stage, an intense activity of scientific information exchange and analysis by the multidisciplinary work team took place, which enriched this document criteria, reports, and opinions. This exchange included an *ad hoc* evaluation of impact relevance performed by experts in biology, ecology, water resources, road engineering, and geology.

5. **Landscape evaluation**: This activity took place first at the field level using water and air transportation to identify, characterize and assess the landscape in potentially impacted areas, determining quality, fragility, and visibility conditions. At the office level, a landscape impact analysis was made.

   To date, aerial and aquatic reconnaissance has been carried out since the complaint was filed in February 2012. These visits allowed us to identify the critical negative environmental impacts on the ecosystem and its connectivity caused by the road that the Costa Rican government is building in the proximity of the San Juan River. Visits at different stages of the project have shown that impacts and damages in the identified sectors have worsened in the short period of time the road has been under construction.

3.2 Impact Assessment

Assessment matrix: A qualitative assessment procedure was followed to measure each expert's perception of the observed and anticipated impact relevance through an assessment matrix system, using parameters for rating impact relevance, such as damage intensity, impacted land area, time for effects to be seen, duration of the impact, environment reversibility, type of impact, likelihood of impacts, impact manifestation over time, and social perception. A weight was assigned to each parameter (Milán, 2004) to estimate a relevance value, with 13 units being the minimum value and 100 units the maximum.

Environmental impacts produce alterations in the environment that may be measured either qualitatively or quantitatively. Quantitative measures of alterations, where feasible, are referred to as **impact magnitude**, which consists of impact dimension in absolute terms, whereas alterations that cannot be measured in magnitude are assessed through **impact relevance**, which consists of weighing a significant impact in relation to the affected environment.

In order to get a balanced criterion on the relevance of the impacts generated by the road construction, FUNDENIC and FONARE decided to convene a group of national experts in different topics related to ecology, hydrology and road construction (Annexes 4, 5, and 7).

4 ENVIRONMENTAL CHARACTERIZATION OF THE SAN JUAN RIVER BASIN

4.1 Description of the Characteristics of the San Juan River Basin

Watershed N° 69, or San Juan de Nicaragua River basin, covers an area of 41,454 km^2. It begins at Lake Apanás, a man-made reservoir located in the department of Jinotega in the north-central region of Nicaragua, and ends at the mouth of the San Juan River on the Caribbean. This basin is viewed as the most important watershed on account of its strategic value in Nicaragua's hydrological system. Given its size, it is divided into three large hydrological units (Table 1).

Table 1: Watershed 69 Hydrological Units

Subbasins	Area (km^2)	%
Lake Xolotlán or Managua	6,669	16
Lake Cocibolca or Nicaragua	23,848	58
San Juan River	10,939	26
Total	**41,454**	100

Source: PROCUENCA, 1997

Lake Cocibolca is a large freshwater lake in Central America, inhabited by approximately 750,000 people. The basin is an important agricultural production area and one of the country's main tourist attractions by reason of the colonial city of Granada and Ometepe Island. In addition, it is the habitat of many species. There are three wetlands in the basin, which were declared of international importance in the 1971 Ramsar Convention (Annex 1). There are several endemic fish species in the lake. The location of the basin in the Meso-American Corridor is a meeting point for North and South American wildlife.

Over the last century, the basin has lost a significant portion of its forest cover to population growth and agricultural expansion, among other things, which caused fragile volcanic soils and steep slopes exposed to erosion, which are thus transported to the lake as sediments that either settle or are carried suspended to the San Juan River. In addition to its importance to fishing and recreational industries, Lake Cocibolca is beginning to be used as a freshwater source by some coastal towns, and its role as a freshwater source may considerably increase in the future to supply many areas in the Central American Pacific region.

Large loads of sediments in the Lake Cocibolca watershed, and nutrients carried both from the national territory and several Costa Rican rivers flowing into the lake along 80 kilometers of the southern lake coast, are one of the major concerns systematically voiced by Nicaraguan experts, as documented in a variety of previous studies and confirmed by this report (PROCUENCA, 2004, CIRA-UNAN, 2009). Table 2 shows the portion of the San Juan River basin located in Costa Rican territory.

Table 2: Portion of the San Juan River Basin Located in Costa Rica

Subbasins	Costa Rica (km^2)	%	Nicaragua (km^2)	%	Area (km^2)
Lake Cocibolca or Nicaragua	4,155	10.8	19,693	51.1	23,848
San Juan River	8,590	22.3	2,347	6.0	10,937
Total	**12,745**	**33.1**	**22,040**	**57.1**	**34,785**

Source: PROCUENCA, 2004

The area draining towards Lake Cocibolca from Costa Rica covers only one-fifth of the entire basin area (not including the lake area): It is largely included in formal protected areas and under environmental service payment agreements. It is estimated, however, that due to steep slopes and precipitation levels, close to 77% of the total sediment load originates in Costa Rica and ends up in the San Juan River (OSPESCA, 2006).

The Lake Cocibolca basin has a unique value. It is rich in biodiversity and a catalyst of economic growth in Nicaragua with the potential to benefit large populations in other Central American countries. This is why several non-governmental organizations in Nicaragua have emphasized the need to protect the lake and its basin.

This hydrological unit comprises 64% of the Nicaraguan territory and 36% of the Costa Rican territory. This basin constitutes the largest topographical depression in the isthmus, the Nicaraguan Graben, a young tectonic structure where northern and southern continental masses meet. It is the most unlimited and open natural depression in the continuum of western hemisphere mountain ranges, and facilitates air mass movements between both oceans. It often acts as a transit corridor for Atlantic anticyclones in their passage to the West, which together with Lake Nicaragua's vast water mirror with high evaporation levels, as well as tropical moist forest areas with high evapotranspiration, play a critical role in creating the cloud system and rainfall pattern in the Central American region all the way to the Gulf of Mexico. This attests to the basin's global importance in the regional and Meso-American system (PROCUENCA, 2004).

From a biological point of view, the basin is a natural corridor and breeding ground for biological species from nearctic and neotropical biogeographic regions, particularly characterized by a rich biological diversity with a strong endemism, making this territory a highly sensitive environmental zone due to the quality of existing resources and its protected nature as the Southeast Nicaragua Biosphere Reserve. The San Juan River hydrological unit itself is the last in this giant aquatic system; it runs from its source at the San Carlos lacustrian port to its mouth on the Caribbean: **the physical area where the road is being built on Costa Rican territory.**

The San Juan River starts in Lake Cocibolca and flows from west to east along approximately 205 km until it discharges into the Caribbean at two places: the San Juan del Norte lagoon in Nicaragua and the Colorado branch in Costa Rica, both some 20 km apart.

The upper San Juan River, from its source to the mouth of the San Carlos tributary river is narrow, deep, without islands, and with some rapids. On the other hand, the lower portion of the river is wide, shallow, with several islets, and forming a delta close to its mouth. The river flows slowly because there is just a 30-m elevation difference in its entire 205-km length, which favors a higher sedimentation rate.

Nicaraguan tributary rivers are short and come down along gentle slopes from elevations ranging from 400 to 600 meters above sea level. On the contrary, Costa Rican tributaries contribute approximately 85% of the total San Juan River flow rate, run over steep volcanic soils coming down from 3,000 meters above sea level to 30 m elevations, which favors sediment entrainment and silting because of changes in soil uses (from forest to agriculture) related to production and economic activities (Figure 1).

4.2 Environmental Situation in the Area

By reason of the highly sensitive environmental characteristics of the above described river ecosystems, easily disturbed by human activities, their ability to recover from environmental degradation is more limited.

Figure 1: Image of San Juan River subbasin in Costa Rican territory
Source: NASA

"*Within a conserved ecosystem, there are functions that become essential to its maintenance and organization (e.g., air and water purification, fertile soil generation and preservation, crop and wild vegetation pollination, seed dispersal, nutrient recycling, etc.), which are directly affected at the disturbance stage leading to environmental impairment with large biological implications.*

Conservation and management using resilience as a bio-indicator allows including human activity role in ecosystem functioning, building the basis for predicting both present and future ecological changes, such as identifying ecosystems most vulnerable to disturbances (Dornbusch, 2004)."

Thus, even if there were no such a broad and sufficient knowledge of an ecosystem or community where an intervention with works, such as the road, is planned (which is not the above described case), the caution principle should be applied and the ecosystem should be ranked as having a high environmental sensitivity until more representative data are available, in line with this assumption, which is also included in most environmental legislation in Central America and Nicaragua.

Therefore, based on the above and prior to considering any action related to San Juan River terrestrial and aquatic ecosystems, it is worth mentioning that constant changes in soil use and uncontrolled agricultural practices traditionally carried out in Costa Rican territory have notoriously contributed to degrading this body of water due to sediment yield from sub-basins located south of the river. On the other hand, the Nicaraguan side is protected by the San Juan River Biosphere Reserve, a part of the Meso-American Biological Corridor that both countries are committed to conserve.

Due to practices inconsistent with the commitments made by the Costa Rican government on environmental protection in a basin shared by both countries, environmental problems found on Costa

Rican territory have had cumulative effects on the San Juan River, which are briefly described in the paragraphs below.

4.2.1 Damage to San Juan River Water Quality

According to laboratory tests, sediments found in the Sarapiquí River, a Costa Rican tributary of the San Juan, show high values of copper, nickel, iron, and other elements from three samplings (Sampling dates) indicating a high contamination from elements. Magnesium concentration values in all samplings are also consistent with highly polluted sediments. The same situation was found for zinc concentration in suspended solids of two out of three samples, where high values of this cation were signs of high pollution levels (PROCUENCA, 2004).

As part of the PROCUENCA 2004 project, a request was made to Universidad de Costa Rica's Nuclear Physics Laboratory to perform X-ray fluorescence (XRF) tests on sediments in a sample from the Sarapiquí River and in another sample from the San Carlos River to ascertain whether or not values obtained through the different techniques were consistent. As it happened, test result values were consistent with those found in samples with high iron, magnesium, zinc, and copper concentrations.

At several sampling points on the San Juan River, the presence of heavy metals, such as aluminum, has been found in water transported by volcanic origin sediments from Costa Rica. These were found in Sábalos and Santa Cruz rivers and in the delta. Metals such as iron, copper, zinc, and manganese are not found in concentrations hazardous to human life, with the exception of aluminum, which exceeds values allowed in preserving human health and wildlife. These metals in water come from a high erosion of volcanic soils in Costa Rican territory.

Pesticide levels in the San Juan River are low. The presence of organochlorine compounds, however, the use of which has been globally banned due to their high persistence and potential hazard to every living organism, including humans, should currently be a great concern.

These pesticides were also detected in water and sediment matrices at the mouth of Costa Rican tributaries in studies carried out by CIRA-UNAN (2008). This is a worrisome finding because, although organochlorine compound marketing and use has been banned, some of them, like pp-DDT (0.14 ng/g) and its breakdown products, are still present in the environment. Molecules of these chemicals found in Infiernito River water and sediments and in both San Juan River compartments suggest a recent use of pp-DDT, together with use in past decades, as shown by detected metabolite (pp-DDE and pp-DDD) concentrations. This could be a reason for great concern because previous studies have also reported the presence of these molecules in the San Juan River.

Other compounds having a lower environmental impact but seen as a potential hazard to aquatic organisms were also found. A higher transport of these compounds to the San Juan River cannot be ruled out during the rainy season.

Figure 2, Erosion Map, shows in red the high erosion process in Costa Rican subbasins, which has been ranked as severe and worsened on account of soil overuse. The same situation is found in soils used for cattle-ranching activities, where water erosion is worse because of extensive cattle-raising practiced by most farms, where pastures have been established mostly on land with forest capability. These inappropriate ways of using the soil lead to soil compaction and reduce soil water storage capacity.

A tributary of the Sarapiquí sub-basin is El Sucio River, which owes its name to its turbid colored water caused by the large amount of sediments it carries as a result of steep slope soil erosion on the upper river section and materials transported by rainwater.

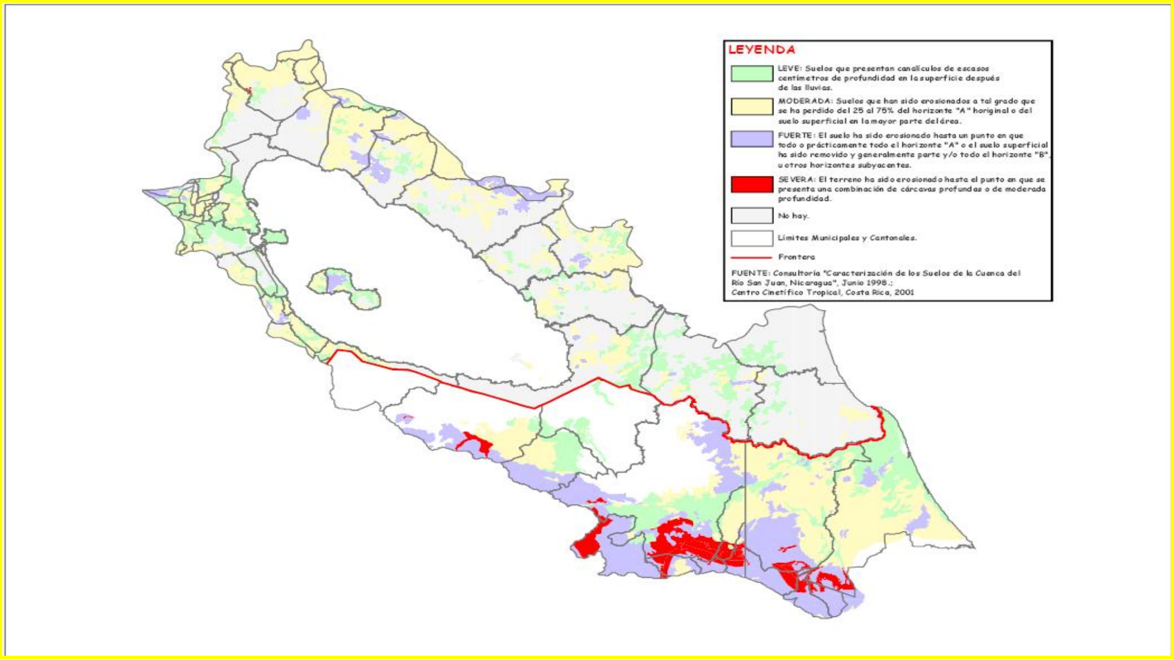


Figure 2: San Juan River basin erosion map
Source: MARENA, PROCUENCA, 2004

According to PROCUENCA, 2004, the Costa Rican Sarapiquí River has high sediment concentrations (864—103.7 tons/day), the same as the San Carlos River (1,209.6—35.6 tons/day). Nonetheless, the latter presents events with loads higher than Sarapiquí. This is one of the main Costa Rican sub-basins due to its great natural wealth and important economic development in the area. Agricultural, agro-industrial, commercial, natural resource extraction, and tourism activities take place here.

The higher elevation parts of Costa Rican sub-basins consist mostly of open areas used for dairy and beef cattle grazing, as well as to protect the Poás Volcano, Braulio Carrillo, and Juan Castro Blanco national parks. While these areas continue to be used mainly for cattle grazing, land use has significantly shifted to planting such intensive crops as pineapple and banana. About 87% of the water volume granted in concessions in this basin is used to generate electric power, the second largest activity being agriculture, which uses 13% of the total water volume.[1]

Although samples taken in Costa Rican territory provide little information on Sarapiquí River water quality, if the shift in land use to pineapple and banana monocultures is taken into account, the likelihood of pesticide, nutrient, and sediment contamination becomes high.[2] The State of the Nation Report acknowledged how important it is for Costa Rica to use the Sarapiquí River for hydropower generation, but it also emphasized that the upper sections of this river were deforested for cattle raising, which is creating a large environmental impact downstream.

[1] Thirteenth Costa Rican State of the Nation Report on Sustainable Human Development, 2007.
[2] Ibid.

Finally, it may be concluded that the main causes of increased amounts of sediments flowing into the San Juan River from Costa Rica are the following:[3]

- Road construction (opening trails and roads in all the sub-basins)
- Expansion of the agricultural frontier without conservation techniques
- Non-metal material mining for construction

On the other hand, human activities in northern Costa Rican sub-basins significantly contribute to water quality reduction because cities generate untreated or poorly treated solid waste, as well as home effluent disposal in San Carlos, Sarapiquí, Upala, Los Chiles, Guatuso, La Cruz, and Pococí. According to data in the Costa Rican State of the Nation Report,[4] an estimated 70,000 metric tons of solid waste per year is generated in San Carlos and Sarapiquí basins, of which 20,000 metric tons per year are left uncollected, namely, 3 tons per km^2/year, and there is only one open dump available. Ultimately, all this untreated waste ends up in the San Juan River, thus affecting water quality along with aquatic wildlife and plants.

Figure 3 shows two photographs where concentration of sediments from Costa Rican rivers can be seen in water color difference. On the left, the mouth of the Sarapiquí River, and on the right the San Carlos River, coordinates UTM 794-57E/1207-986N. Figure 4 shows two Costa Rican backhoes extracting sediments from the San Carlos River to build the bridge over the river that will connect with the road under construction along the San Juan River.

Figure 3: Water quality comparison to Sarapiquí and San Carlos rivers
Source: FUNDENIC, 2012.

4.2.2 Damage to the San Juan River Water Flow Rate

It took Costa Rica seven years, from 1948 to 1955, to dredge the Colorado branch without notifying or requesting permission from Nicaragua, with no study of damages caused to the San Juan River and Nicaragua. The dredging of the channel was carried out by Costa Rica in order to get a higher flow rate at the expense of the San Juan River, thus significantly contributing to a reduced flow rate downstream from the delta. This has accelerated negative silting effects on the Nicaraguan part of the delta, making aquatic species breeding difficult, diminishing fish species, and hindering navigation.

[3] Thirteenth Costa Rican State of the Nation Report on Sustainable Human Development, 2007.
[4] Thirteenth Costa Rican State of the Nation Report on Sustainable Human Development, 2007.

Figure 4: Embankments to build a bridge over the San Carlos River
Source: FUNDENIC, February 11, 2012.

Figure 5 shows how most of the San Juan River flow was diverted to the Colorado branch, while the San Juan River was reduced to a narrow channel. Sedimentation brought by Costa Rican rivers to the San Juan, in addition to Costa Rican dredging of the Colorado branch in past decades to take away more water from the San Juan River, can be clearly seen on the satellite picture taken in 2007.

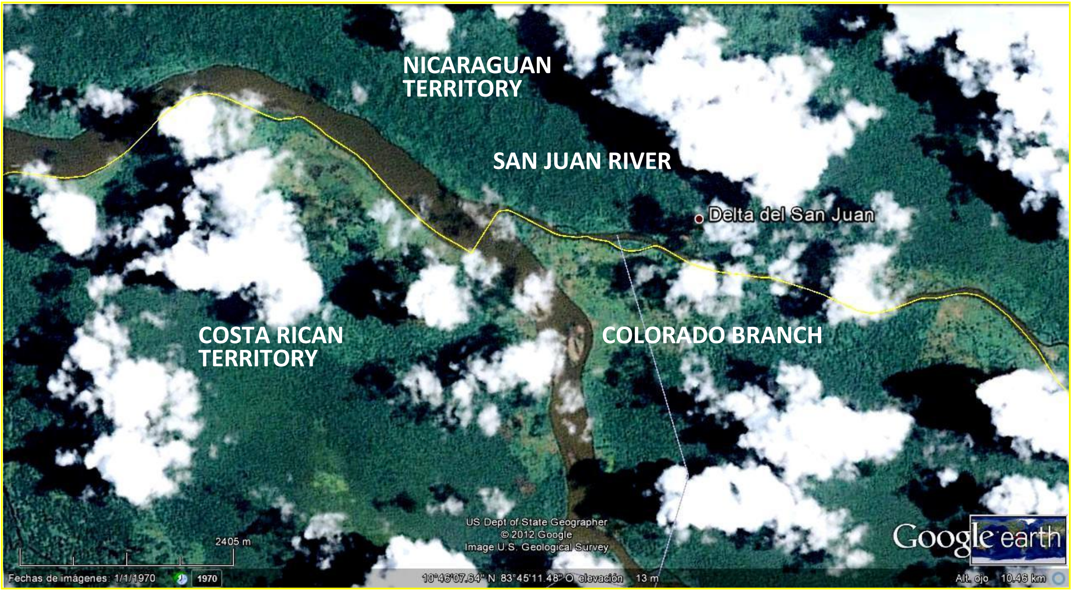


Figure 5: Comparison between San Juan River and Colorado branch channels
Source: Google Earth, 2007

Evidence of the large volume flowing through the Colorado branch is the high sediment concentration it discharges into the Caribbean. A net sediment yield of 1.8 x 10^6 metric tons per year was estimated to come from the system's southern sector.[5] Nutrients are reflected on water turbidity; nutrient fronts at river sediment plumes can be seen reaching out 3—15 km into the Caribbean Sea continental slope at a 10-meter depth in the Colorado mouth and at 20-meters in the San Juan River mouth. Colorado channel unilateral dredging and expansion activities did not recognize Nicaragua's exclusive and sovereign dominion over the San Juan River, a right that was also reaffirmed by the International Court of Justice at The Hague in July 2009. Regarding this matter, the current construction of a road along the San Juan River's right bank will multiply water sedimentation, which should be viewed not only as a damage to Nicaragua, but also as an irreversible impact on Costa Rican territory.

4.2.3 Assessing negative impacts on biodiversity by Costa Rica's new land use and deforestation in the San Juan River basin

The 2004 Report on Carbon Dioxide Emissions and Fixation in Forests prepared by the government of Costa Rica indicated that 9,100 hectares of forest cover were lost in 1997-2000 in said country, amounting to an annual rate of 3,000 ha down from the 1997 rate, which confirms a strong tendency to reduce the land use shift process. In fact, deforestation rate in the '60s and '70s was 6,000 ha per year, one of the highest in the world (MINAE and UNEP, 2002). According to data in State of the Nation reports, Costa Rica has suffered biodiversity losses, for example, 17 reptile and amphibian species populations at La Selva Biological Reserve in Sarapiquí, showing as much as 75% decrease as a result of habitat reduction.[6]

Costa Rican soil degradation is caused by forest cover loss and the resulting fertility decrease, which increases runoff and hinders or slows down soluble nutrient infiltration and percolation processes. By and large, forest area reduction comes together with land use shift in favor of crops using inadequate technologies that compound erosion processes and facilitate organic matter and soil fertility losses (MINAE, 2004).

Forest area reduction in Costa Rican territory leads to fragmentation of the habitat of many species living in ecosystems shared by both countries, and contributes to major damages arising on river banks from lack of vegetation and soil constitution. The shift in soil use from forest to agriculture on the San Juan River's right bank in Costa Rican territory can be seen in Figure 6, whereas the left bank is conserved in the Indio-Maíz Biological Reserve on the Nicaraguan side.

It can thus be summed up that the San Juan River basin is an area of high environmental sensitivity on account of its natural characteristics, quality of resources, and protected area nature, which has been purposefully designated as the San Juan River Biosphere Reserve.

[5] Thirteenth Costa Rican State of the Nation Report on Sustainable Human Development, 2007.
[6] Fifteenth Costa Rican State of the Nation Report, 2009.

Figure 6: Expanding deforestation process in Costa Rican territory
Source: FUNDENIC, 2012

Cumulative environmental damage is being produced in the San Juan River, the right banks of which form in part the border between Costa Rica and Nicaragua, as a consequence of impacts from accelerated and intensive land use and environmentally harmful agricultural practices carried out by Costa Rica in an environmentally sensitive area. This zone is recognized and protected by binational, regional, and international agreements and conventions by reason of its being suitable only for natural resource conservation and protection, not for developing harmful infrastructure, such as the road Costa Rica is building along the river banks.

5. DESCRIPTION OF ROAD CHARACTERISTICS

To date, there is no official information available on the road construction project being implemented along the south border, although the Nicaraguan Foreign Ministry has repeatedly requested such information from its Costa Rican counterpart. Hence, project data hereby reported are taken from statements made by Costa Rican government officials (Francisco Jiménez, Minister of Public Works and Transportation, among others) and published in the media.

5.1 Technical Data regarding Road Construction

1. **Location**: It starts at the Nicaragua-Costa Rica border and lies within the inalienable Nicaragua-Costa Rica Border Corridor National Wildlife Refuge, which extends from Punta Castilla on the Caribbean to Salinas Bay on the Pacific.

2. **Total 160-km Length**: For some 40 km, the road runs parallel to the land border (between Los Chiles and Milestone N° 2), but for the remaining 120 km it hugs the San Juan River's right banks very tightly until it ends at the delta. Thus, it is disturbing the remnants of moist tropical forests and blocking the drainage of natural bodies of water flowing to the San Juan River from Costa Rica (Figure 7).

Figure 7: Road layout along the San Juan River's right bank
Source: FUNDENIC

3. **Right-of-way**: 50 meters and 14—20-meters wide.

4. **Type of road**: Rural gravel road.

5. **Road construction**: The National Road Council (CONAVI) is in charge of building the road and has used 700 machines and employed over two thousand people from the region.

6. **Cost**: US$ 20 million.

7. **No Environmental Impact Assessment was made**, according to statements made by the Costa Rican Foreign Minister and published in Nicaraguan national media.

6. IDENTIFICATION AND ASSESSMENT OF ROAD CONSTRUCTION ENVIRONMENTAL IMPACT

6.1 Outcomes from Field Visits

Several visits were made at the different road construction stages by water and air.

Based on statements made by Costa Rican government officials and on-site observations, this road construction lacks the following:

1. **Environmental Impact Assessment**: Since there is no environmental impact assessment available, no mitigation actions required to preemptively abate construction impacts were identified. As a result, applying these measures after the fact to prevent potentially adverse present and future impacts becomes difficult or impossible. Similarly, actions required for lessening negative environmental effects during road useful life will not be anticipated.

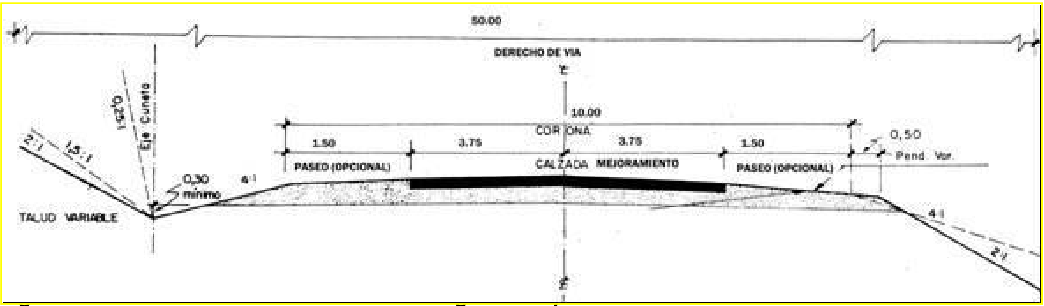
2. **Layout and Works Design**: The makeshift road layout is irregular and whimsical with no geometry on river bends and on the immediate terrain relief, tightly hugging river curves without any technical design principle. The road layout does not blend in with the landscape, "*taking into account its integration should be part of the scenery and especially share in scenery appreciation and character*" (Centro de Estudio y Paisajes del Territorio, Junta de Andalucía, 2008).

3. **Topographic Supervision**: Surveying tasks make sure the previously designed layout and the road cross-section are built as planned in design drawings to achieve road quality and sustainability.

6.1.1 Defining the Area of Influence of the Road Construction

In order to study and assess environmental impacts, the road area of influence was defined taking into account each environmental factor and considering sensitivity of natural resources and the pressure they will be subject to, as well as visual impacts on the landscape.

Based on this definition and on available data the road cross-section was designed for a 50-meter right-of-way (Figure 8).



Source: Published date on road to illustrate the right-of-way.

As seen on the figure, the right-of-way includes the road surface, the slopes required for the earth to rest without eroding, gutters and culverts when technically required, as well as works to prevent culvert and drain erosion.

The **area of direct influence** was defined considering the occurrence of direct and indirect high-intensity impacts, and includes typical road construction and material sites. This area is estimated to cover 500 meters from the right-of-way and includes stockpiling of borrow materials and other road hydrology and drainage works.

The **area of indirect influence** was established taking into consideration socioeconomic aspects and social, administrative, and political dynamics according to impact probability and frequency, which decrease exponentially with distance from the road. This area encompasses approximately one kilometer from the area of road direct influence all the way to the river mouth.

These influences have immediate effects, not to mention the progressive and increasing range of effects related to the development of future activities encouraged by the presence of a border road (increased commercial smuggling, drug trafficking, irregular settlements, deforestation, new land uses, waste from tourist facilities, various kinds of waste and effluents, etc.).

Technical shortcomings leading to environmental impacts:

1. In line with the above section and based on visual evidence, it can be stated that **the road under construction invades Nicaraguan territory at some points** (See Figures 9 and 10).

   Figure 9 shows a milestone lying within the road embankment slope. In Figure 10 the culvert appears without such protection works as headwalls, cutoff walls, and wing-walls at culvert outlets to retain slope fill materials. As a consequence, this is favoring sediment transport.

Figure 9: Milestone N° 6 within road embankment slope

Figure 10: Culverts located on Nicaraguan territory

2. No precautions were taken during road construction works to prevent damages and nuisance to Nicaraguans living next to the border, as ascertained by Fidel Rodríguez and Mayra Blandino L. in their visit to the site, where they found the following damages:

   - Fence destruction in residents' properties.
   - Crop damages (Figure 11).
   - Residents are exposed to accident hazards by the presence of heavy machinery and equipment near their homes (Figure 12).

- Reduction in property area due to inaccurate borderline delimitation resulting from lack of milestone density.

- The lack of design for a road of this magnitude amplifies the environmental impacts produced by any road project. This is particularly true when it is built in an environmentally fragile or sensitive area because no environmental measures were considered to minimize adverse environmental effects neither at the planning stage nor during road construction, operation, and maintenance.

Figure 11: Crop damages

Figure 12: Dwelling at edge of road slope

Aware of this need, the Central American Economic Integration Secretariat (SIECA), under USAID Agreement N° 596-0184.20, created the "Central American Manual of Environmental Standards for Road Design, Construction, and Maintenance" in 2002, laying down environmental norms for the different road development stages. Said document was meant to be used in developing the region's environmentally and economically sustainable road projects. This Central American integration instrument was infringed by Costa Rica, as evidenced on Table 3.

The term "environmental impact" is associated with a socially important effect and is thus defined as any significant alteration in the environment caused by human actions, whether positive or negative. So, a project impact on the environment is the difference between the future modified environmental situation, as it would be as a consequence of project implementation, and the future environmental situation as it would have normally evolved without such an intervention, that is to say, the net (positive or negative) alteration resulting from an action, where impact variation with the passage of time can also be seen (CONESA, 1995, p. 25).

Table 3: Some Environmental Regulations in Designing Roads, According to SIECA's Central American Road Manual

1. Road layout should be designed to minimize possible earthmoving.	 Earthmoving performed to build this slope is large and erosion effects can be seen in the development of grooves due to this area's prevailing weather conditions.
2. The road should cross the smallest possible number of watercourses, both permanent and temporary (rainwater creeks).	  The number of required drainage works could not be determined during an on-site evaluation. However, based on topographic characteristics of the terrain where road construction layout was defined, an estimate of 5 to 10 15-m-long culverts per kilometer would be required. At project completion there could be some 900 to 1000 culverts.
3. Stable soils with good permeability should be preferred to minimize problems arising from ground water in sites with shallow phreatic levels.	 Prevailing clayey soils are very unstable.
4. The project feasibility study should include in the EIA the costs of mitigating and offsetting all potential direct and indirect environmental impacts identified, analyzed, and valued resulting from road construction.	The fact an Environmental Impact Assessment was not prepared is already known, and no geological studies have been published to insure works quality. The road layout has not either anticipated mitigation measures because road edge distance from Nicaraguan territory, including the San Juan River, is minimal. Field research, information based on geodesic maps and GPS, and visual inspection of the borderline along the San Juan River banks revealed the 120-km road stretch layout between border milestones N° 2 and 12 was defined

	without considering geological and hydrological parameters, such as: ➢ Soil specific gravity and relative density. ➢ Fill materials consolidation and permeability. ➢ Soil shear strength ➢ Slope stability (angle of repose) ➢ Soil liquefaction ➢ Flow rate calculations for hydraulic works construction Geological studies conducted in Nicaragua by expert geologist Dr. William Ramírez on the San Juan River confirmed this river's geological terrain is a graben, a new rift valley formed by an oceanic crustal extension resulting from changes in Cocos Plate subduction pattern (it goes from an oblique angle to semi-vertical), induced among other factors by the Cocos Ridge subduction starting in the Middle to Late Miocene (≈ 15 million years ago). In this respect, it is worth mentioning that the San Juan River irregular course follows a strike slip fault system on account of WNW fault and fracture structures associated with the Hess Escarpment system. This system reflects convergence rate changes in geological time between Cocos and Caribbean plates, while being modeled by dip fault and fracture traces mostly with NNE to NE strike. There are two kinds of evidences in identifying faults along the river and surrounding areas. The first type of evidence is found in topographic maps and satellite and radar image interpretation, where the main lineaments were identified in the area. On field verification these lineaments matched the presence of structures, both cross-cutting and parallel to the river course, reflected either on heavily fractured rocks and hydrothermal alteration, or on alluvial-illuvial secondary materials typical of fault fill zones. These elements contribute to the area's proven seismic nature. There is no evidence of compliance with this.
5. When road corridors traverse areas adjoining or influencing protected areas the EIA should include an area management program with a component for "in situ" conservation of endemic, threatened, or endangered species. The management program will also include a manual of procedures to be followed by project workers after receiving relevant training.	

Source: Site Assessment Report, Fidel Rodríguez and Mayra Blandino L, December 6, 2011; El Nuevo Diario, December 20, opinion article by Mayra Blandino; San Juan River Geological Environmental Characterization, Dr. William Martínez, January 2012; photographs, Diario El 19 Digital; Manual Centroamericano de Carreteras, SIECA, USAID, 2002.

Figure 13: Culvert with a smaller diameter than recommended
Source: Technical mission

Figure 14: Cross-section of inadequately sloped embankment
Source: Technical mission

Both the culvert diameter and material show it has no capacity to bear the embankment weight. As a consequence, the pipe exhibits an oval section rather than a circular section, indicating it **does not have** the strength for load bearing. This will create a drainage clog with the possibility of materials sliding to the river located right across (Figure 13).

The cut slope for clayey soils should be 1:2 or 1:2.5. A look at the cross section in Figure 14 (on the left) shows a 1:1 slope (90 degrees). There is a very high probability of this earth sliding into the river in an area with high precipitation such the San Juan River.

6.2 Identification of Environmental Impacts Caused by the Road

Identified negative environmental impacts from the road have been classified for two stages, namely:

a. During road construction (current stage). See Table 4.

b. During road operation and maintenance (should the project be completed). See Table 5.

Table 4: Main Environmental Impacts Identified During Road Construction

Activity / Causes	Effects
Stockpiling of materials	**Impacts on Physical Environment**
	Destruction of geomorphology in unstable soil areas
Earthmoving: clearing and uprooting, roadway excavations, sub-excavations, unclassified borrow materials (when	Natural landscape destruction
	River sedimentation from sliding slopes
	Increased soil erosion from vegetation cover loss
	Sediment yield obstruction of small streams flowing to the San Juan River
	Hydrological regime and surface runoff modification due to land use changes
	Soil destruction and compaction
	Vegetation cover loss from gallery forest destruction at some points along the San Juan River's right banks
	Air and noise pollution from equipment, machinery, and workers used in road construction
	Damages in wetlands protected by the RAMSAR Convention (Maquenque Site and northeast Costa Rica)
	Surface water quality impairment

material stockpiling is used), embankment and slope construction, wedge construction with site materials.	Natural landscape destruction	
	Invasion of Nicaraguan territory	In cases where earthmoving has taken place at the land border boundary
	Damages to Nicaraguan citizens' property	
	Ecological Impacts	
	Flora composition modification	
	Connectivity damages to species and ecosystems in the Meso-American Biological Corridor	
	The noise created by works causes species migration	
	Major ecological factors, such as diversity and abundance, are affected. These impacts are also produced on the various species living in the San Juan River. A grouping provided by Mr. Fabio Buitrago has been prepared to estimate impact on the different species. (See classification of affected species)	
	Social and Economic Impacts	
	Social and economic impacts on people living on the Nicaraguan side and whose livelihood depends on the San Juan River will become evident to the extent many of the above mentioned physical and ecological impacts arise, due to negative effects on fishing, navigation, trade, and tourism, among others.	

Table 5: Main Environmental Impacts During Road Operation

Causes	Effects
Vehicle traffic and road maintenance	**Impacts on Physical Environment**
	Since this is an improvement road and no environmental measures were adopted to abate sediment transport, the river silting process and slope sliding hazard will continue and grow
	Increased soil erosion
	Air and noise pollution
	Drainage area expansion towards river banks due to growing erosion
	Risk of San Juan River water becoming contaminated by hydrocarbons (greases and fuels) from traffic and probability of accidents
	Ecological Impacts
	Vehicle traffic will increase ecological impacts leading to connectivity damages to species and ecosystems that are part of the Meso-American Biological Corridor
	Vehicle traffic noise causes species migration
	Major ecological factors, such as diversity and abundance, are affected. These impacts are also produced on the various species living in the San Juan River. A grouping provided by Mr. Fabio Buitrago has been prepared to estimate impact on the different species. (See classification of affected species)
	Social and Economic Impacts
	Road vehicle traffic will generate cumulative impacts on a highly sensitive environmental area, such as the Southeast Nicaragua Biosphere Reserve because the road will act as a vector leading to new impacts, such as territorial anthropization (settling) and growth in human settlements, which results in contamination from liquid effluents, solid waste, noise, and irreversible transformations in land uses. Increased accessibility produced by the road will create a negative effect on the Biosphere Reserve adding new environmental pressures, such as poaching, natural resource extraction, and other illegal activities coming from Costa Rica. The road will also increase pressure on the Nicaraguan security system, involving additional costs to the country to strengthen border security and cross-border drug traffic control. The road will increase illegal migration by people trying to find employment opportunities in Costa Rica or seeking the "American dream". These factors will transform San Juan River traditional activities related to fishing, economy, trade, tourism, and navigation.

6.1.2 Images Supporting Some of the Above Assessed Impacts

Table 6 shows images of the countless negative environmental impacts.

Table 6: Description of Main Environmental Impacts Observed in Field Visit

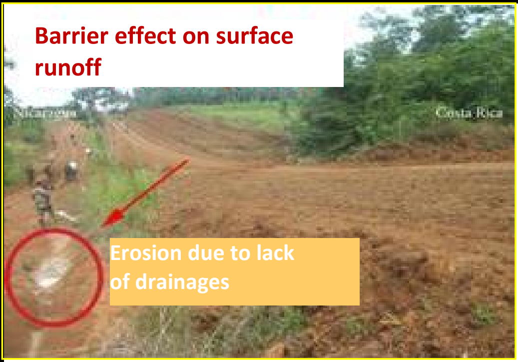


Figure 15: Soil being washed off by surface runoff	**Figure 16: Man-made drainage canal altering hydrological regime**
	
Figure 17: Destruction of gallery forest protecting the right bank of the San Juan River	**Figure 18: Sediment disposal site on the right bank of the San Juan River**

Figure 19: Drain discharging in the San Juan River

Figure 20: Geomorphology alteration in unstable areas

Figure 21: Significant increase in sediments on the right bank of the San Juan River

Figure 22: Significant increase in sediments on the right bank of the San Juan River

Figure 23: Slope landslide and soil erosion on river bank

Figure 24: Gullies formed on slopes

Figure 25: Barrier effect damage on Maquenque wetland (RAMSAR site)

Figure 26: Barrier effect damage on northeast Costa Rican wetlands

Figure 27: Machinery concentration increases air and noise pollution levels

Figure 28: Barrier effect on natural lagoon and river system

Figure 29: Increased sediments from barrier effect on small stream courses

Figure 30: Accelerated erosion has damaged slope-covering fabrics

Source: Technical mission

6.1.2 Impacts Generated During the Road Construction Stage

At this moment, direct biodiversity impacts can observed in the area, such as the following:

- forest area destruction to build the road;
- ecosystem continuity loss;

- obstruction and pollution of several rivers flowing into the San Juan River, thus limiting aquatic species circulation;
- high sedimentation rate due to earthmoving;
- increased human presence in the area with a resulting higher use of natural resources for consumption purposes;
- contamination from solid and liquid waste produced by more people working in the area;

These impacts could be viewed as transient or mitigable. However, no known mitigation measures have been anticipated to prevent or minimize impacts caused by road construction.

6.1.4 Future Impacts During Road Operation

Even more worrisome than construction impacts are potential impacts occurring during operation once the road is completed. Vehicle traffic in the area will entail the following ecological problems unanticipated by both the building company and the government of Costa Rica:

- wildlife road kill;
- increased hunting in the area, given there will be more and better access conditions, mainly for poaching in Nicaragua;
- increased tourist visitation in the area, and therefore more tourist infrastructure, solid and liquid waste, and noise pollution;
- noise pollution from vehicle traffic;
- pollution with gas emissions from vehicle traffic in the area;
- growth in roadside human settlements, thereby increasing pressure on Nicaraguan natural resources (fishing, hunting, firewood, lumber, etc.);
- Overhead power line construction along the road, thus causing a high wildlife electrocution rate.

This document is based on field observations made during exploratory trips to the San Juan River. Since road construction plan, environmental impacts foreseen in said plan, and mitigation measures were not known, the best expert judgment together with information on similar experiences were used to compile the likely biodiversity impacts. These impacts could be higher if additional, parallel, or complementary works are developed on the Costa Rican road.

6.2 Critical Points Caused by Road Construction

Assessments made in this document use the term **critical point** in referring interchangeably to one point, or set of points, or road segment that by reason of environment sensitivity or land capability, type of intervention made, or proximity to the San Juan River creates major hazards that may lead to immediate or short-term (up to two years) effects, which warrant monitoring because damages arise from a cause-effect relationship. Damages do not often become immediately apparent but rather until some time has elapsed for impact magnitude to become evident.

Many critical points have also been identified from Nicaraguan territory, which is why a detailed assessment of the induced hazard magnitude cannot often be made. A total of approximately 300 critical points have been identified. Table 7 presents some of them.

Table 7: Images of Some Critical Points Identified From Nicaraguan Territory

	
Figure 31: Critical point owing to risk of substances spilling over the San Juan River	**Figure 32: Critical point owing to risk of affecting San Juan River flow rate**
	
Figure 33: Critical point owing to risk of road flooding along the San Juan River	**Figure 34: Critical point due to severe geomorphological damage in a geologically unstable area**
	
Figure 35: Critical point due to potential road flooding along the San Juan River	**Figure 36: Critical point due to geological instability**

Figure 37: Critical point due to slope instability and ongoing erosion process

Figure 38: Critical point due to silting in the river channel

Figure 39: Critical point due to slope instability and ongoing erosion process

Figure 40: Critical point due to slope instability

Figure 41: Critical point due to sediment runoff to river

Figure 42: Critical point due to slope instability

Figure 43: Critical point due to slope instability

Figure 44: Critical point due to channel edge erosion at the river's right bank accelerated by road

Figure 45: Critical point due to risk of flooding along the San Juan River

Figure 46: Critical point due to sedimentation of road drainage system

Figure 47: Critical point in view of river silting and road flooding

Figure 48: Critical point due to slope instability

Figure 49: Critical point due to slope instability

Figure 50: Critical point due to slope instability

Source: FUNDENIC, 2012.

6.3 Impacts on Ecological Biodiversity

The southeast Nicaraguan and northeast Costa Rican region is a very valuable narrow biological corridor as a biogeographic corridor. It contains the last viable connecting habitat on undeveloped land that enables to maintain a continuum of the Meso-American Biological Corridor between both countries. This is why both Nicaragua and Costa Rica have made big efforts to create protected areas and biological corridors. At least 19 (15 terrestrial and 4 aquatic) natural ecosystems and 2 humanized ecosystems have been identified. In the attached Decree 66-99 (Annex 2) is an updated list of the categories and boundaries of southeast Nicaragua protected areas.

Paragraph 3.3 of the San Juan River Biosphere Reserve Fact Sheet (Annex 3) reads: "Southeast Nicaragua Biosphere Reserve coordinated management with protected areas in north Costa Rica (each maintaining its own individuality and sovereignty) would largely contribute to establishing and consolidating the Meso-American Biological Corridor. These considerations would assume future conservation and sustainable development actions will be implemented in accordance with criteria of respect for laws and principles governing natural systems (ecosystems), overcoming any incoherence associated with the establishment of national, cultural, or administrative boundaries."

Opening new means of communication, however, will cause negative environmental effects, just like all infrastructure works and human actions. The most significant ecological effects from roads can include: ecosystem fragmentation, exotic species dispersion and decrease in native wildlife and plant species populations, blocked migrations of gallery forest biological populations, hydrological cycle alteration, microclimate changes, particle matter and noise generation, water and soil pollution, etc. Opening settlement fronts has a strong indirect impact that may lead to medium- and long-term land use reconversion, natural habitat destruction, and reduced biodiversity.

Environmental impacts on biodiversity caused by road construction along the San Juan River can be broken down according to the following ecological criteria:

1. Mobility
2. Home range
3. Disturbance sensitivity and tolerance
4. Species uniqueness

5. Ecological replaceability

Impacts on environments where these species live or go through could also be classified, such as, fresh water, salt water, tropical forest, air space. Table 8 shows the main species affected by anticipated road construction impacts.

Table 8: Classification of Species Affected by the Road

Ecological Criteria	Species	
	Common Name	**Scientific Name**
Migratory species or species with a wide home range	Jaguar	*Panthera onca*
	Tapir	*Tapirus bairdii*
	White-lipped peccary	*Tayassu pecari*
	Harpy eagle	*Arpya harpija*
	Tarpon	*Tarpon atlanticus*
	Snook	*Centropomus spp.*
	Bull shark	*Carcharinus leucas*
	American crocodile	*Crocodylus acutus*
	River prawn	*Macrobrachium spp.*
	Green macaw	*Ara ambigua*
	White-tailed deer	*Odocoileus virginianus*
Unique species with restricted range or associated to an ecosystem	Manatee	*Trichechus manatus*
	Paca	*Agouti paca*
	Agouti	*Dasyprocta punctata*
	Howler monkey	*Allouata palliata*
	Spider monkey	*Ateles geoffroyi*
	White-faced capuchin monkey	*Cebus capucinus*
	Great egret	*Casmerodius albus*
	Migratory ducks and anatids	several species
	Common slider turtle	*Trachemys scripta*
Highly sensitive species	Bats	several species
	Amphibians	(poison-dart frogs) *Dendrobates*
	Rainbow bass	*Cichlasoma spp.*
	Mojarra	*Cichlasoma spp.*
	Birds	several species

6.3.1 Impacts on Species Mobility

Biodiversity does not have natural boundaries or limits to its range. Therefore, species able to cross the San Juan River could freely move from one country forests to the other's without major limitations prior to road construction. Building such a physical barrier as a vehicle roadway, however, becomes a serious constraint on free movements of land animals having wide mobility ranges (Figure 51). Such is the case of the following animal species, which are the most representative and emblematic in the area:

- Jaguar (*Panthera onca*)
- White-lipped peccary (*Tayassu pecari*)
- Tapir (*Tapirus bairdii*)

- White-tailed deer (*Odoicoleus virginianus*)

In addition to the physical barrier limiting free movement of these large mammals capable of swimming or crossing the river, there are other smaller species affected by road construction, including:

- Paca (*Agouti paca*)
- Red brocket deer (*Mazama americana*)
- Great curassow (*Crax rubra*)
- Green macaw (*Ara ambigua*)

Figure 51: Barrier effect caused by road between wetlands and the San Juan River
Source: FUNDENIC, 2012.

Southeast Nicaragua and northeast Costa Rica are among the few remnants of Central American moist tropical forests that formed the Meso-American Biological Corridor, an initiative endorsed by both countries precisely to foster forest area conservation on both sides of the border and thus create the conditions favoring free wildlife movements. In addition to the above mentioned species, it is worth mentioning that the area is a transit station for a large number of migratory species, especially birds, which would find an obstacle in their migration to other countries further south. Migratory bird species that could potentially be affected can be those in the following taxonomic groups:

- Falconiforms (*eagles, hawks*)
- Piprids (*warblers*)
- Passeriforms (birds living in the Reserve)
- Strigiforms (nocturnal birds of prey)

Many of these birds make very long trips from North America through the narrow Central American isthmus to reach northern South America. This road is an additional obstacle that could be limiting these birds' migratory route and affecting their ecological niche or function in the ecosystem (seed dispersal, food source, pest control, among others).

Another important issue to be mentioned is the impact on aquatic species free circulation or movement. These species will have an impaired ability to travel in the river to the extent road construction discharges sediments that increase water turbidity and reduce the space available for swimming upstream. The river is used by many species, not only fish but also mammals and reptiles, which would be affected by sedimentation coming from the neighboring country to the south, such as the following species:

- Manatee (*Trichechus manatus*)
- Long-tailed otter (*Lontra longicauda*)
- Snook (*Centropomus paralelus/pectinatus*)
- Tarpon (*Tarpon atlanticus*)
- Garfish (*Atractosteus tropicus*)
- River prawn (*Macrobrachium carcinus/rosembergii*)
- American crocodile (*Crocodylus acutus*)
- Spectacled cayman (*Caiman crocodilus*)
- Bull shark (*Carcharinus leucas*)
- Largetooth & smalltooth sawfish (*Pristis perotteti* & *pectinata*)

6.3.2 Impacts on Home Range

A large number of species with variable home ranges gather at the Indio-Maíz Biological Reserve and the San Juan River Wildlife Refuge. Over 600 animal species have been identified in this moist tropical forest ranked as one of the most diverse in the American continent, second only to the Amazon forest.

Survival of many of these species lies on ecosystem landscape continuity, namely, the consolidation of large compact forest areas to reduce border effect and man-made disturbances. Considering both northern Costa Rican and southern Nicaraguan forests were envisaged by the Meso-American Biological Corridor as a single large bloc of tropical moist forest protecting a representative sample of over 50% of Meso-American species, this road construction breaks landscape continuity and, hence, ecosystem ecological integrity. Undoubtedly, this will lead to unforeseen impacts from ecological imbalance and human disturbances in home ranges of many biodiversity species (Figure 52).

6.3.3 Disturbance Sensitivity and Tolerance

Not all species inhabiting forests in southeast Nicaragua and northeast Costa Rica are able to tolerate human presence and its consequences. In fact, many populations of species found in these ecosystems are declining in both numbers and range on account of small changes that go unnoticed by humans, such as in average temperature, relative humidity, and precipitation.

Figure 52: Wildlife species home range disturbances
Source: FUNDENIC, 2012.

Species with a wide home range and high mobility are perhaps the most tolerant to man-made disturbances. But larger species usually are less tolerant of disturbances given their limited ability to escape them.

Species in such groups as amphibians, small reptiles, mollusks, insects, small mammals, crustaceans, and arthropods are locally affected by this infrastructure construction that directly destroys their riparian habitat. Some of these animals are extremely important to local communities as sources of income and development opportunities, such as the river prawn (*Macrobrachium carcinus*), a food and income source for residents of El Castillo and San Juan de Nicaragua municipalities. Other species relevant to local food security are rainbow bass (*Cichlasoma spp*.), mojarra (*Cichlasoma spp*.), snook (*Centropomus spp*.), machaca (*Brycon spp*.), and big-mouth sleeper (*Gobiomorus dormitor*), among others included in local daily diet.

6.3.4 Species Uniqueness

Many species found in southeast Nicaraguan and northeast Costa Rican forests possess high ecological uniqueness rates. Uniqueness is a sign of each species genetic and ecological importance considering its range throughout the continent, abundance in other forest areas, and ability to become associated with particular ecosystem conditions.

Road construction alteration of the region's ecosystem is directly affecting survival chances for many species with high ecological uniqueness rates. Just in the Indio-Maíz Biological Reserve more than 150 insect, bat, amphibian, reptile, and bird species practically non-existent in other Central American tropical moist forests have been reported. Road construction affects ecosystem integrity and thus increases the likelihood of losing species that are unique to humankind, not only to Nicaragua (Figure 53).

It is extremely important to point out that new species for Nicaragua and even several new to science have been reported in every scientific trip to the Indio-Maíz Biological Reserve. This is an indication of the poor knowledge we still have about biodiversity in the Reserve and surrounding areas. By increasing risks, the road will then jeopardize survival of several species that have not yet been discovered, thus depriving humankind from including new species in natural heritage listings. Some of these still-unknown species might hold secrets for drug manufacture, disease cures, chemicals, and other relevant benefits we would no longer have the chance to enjoy.

Figure 53: Plant and wildlife destruction caused by road construction
Source: FUNDENIC, 2012.

6.3.5 Ecological Replaceability

Given many species are unique to these ecosystems, it can be said that ecosystem ecological replaceability is very low. If ecosystem integrity, together with unique species invaluable to humankind, were to disappear a highly irreplaceable loss would be incurred because original biodiversity, not only from the region but also from the planet, could not be restored or extinct populations recovered.

6.3.6 Impacts on the Caribbean Sea

It must be kept in mind that all sediments and pollutants poured into the San Juan River will be transported to the Caribbean Sea, where they will severely affect fishing productivity, which provides a livelihood to thousands of people from both countries. Such communities as Río Maíz, San Juan de Nicaragua, Cangrejera, Barra del Colorado, Tortuguero, etc. rely on marine ecosystems for their subsistence.

Therefore, preventing and reducing environmental impacts from sediments and pollutants should be a priority to both countries in order to secure food and development opportunities for these coastal communities.

6.4 Environmental Impact Assessment by an Expert Team

Matrices were later processed to count with an assessment criterion where evaluator subjectivity was statistically controlled. Results are shown on Table 9. Relevance matrices with each expert's assessed results are shown in Annex 4.

Table 9: Negative Environmental Impact Relevance Matrix during Road Construction, According to Expert Team Assessment

NEGATIVE IMPACT RELEVANCE MATRIX													
		STAGE: CONSTRUCTION											
ENVIRONMENT FACTORS		MARIA RAQUEL CHAVARRIAS	JACINTO CEDEÑO SÁNCHEZ	FABIO BUITRAGO	NORVING TORRES	RICARDO RUEDA	JOE M.ZOLOTOFF PALLAIS	MILTON CAMACHO	ROAD ENGINEERS	Alteration Value	Maximum Alteration Value	Degree of Alteration
Natural physical factors (sediments, runoff, land use changes, pollution, hydrological regime, geomorphology, air quality)	M1	62	52	80	70	88	82	82	68	584	800	73
Ecological factors (connectivity, scenery, species migration, diversity, abundance, ecosystems)	M2	92	46	68	70	100	62	72	64	574	800	72
Social and economic factors (navigation, fishing, trade, tourism, cost of opportunity)	M3	72	32	72	70	92	51	72	50	511	800	64
Mean Relevance Value		70										
Typical Dispersion		16										
Discrimination Range		86							54			
Alteration Value		226	130	220	210	280	195	226	182	1669		
Maximum Alteration Value		300	300	300	300	300	300	300	300		2400	
Degree of Alteration		75	43	73	70	93	65	75	61			70

According to assessment procedure, the minimum value was 13 and the maximum 100. The resulting 70 average was deemed as having a severe impact relevance. In statistical processing of values assessed by experts, only 4 out of 24 probable values were lower than average minus one standard deviation, and 4 were above the mean value plus one standard deviation, which means 16 values (67%) fell within average value (a good criteria matching level).

A similar assessment was subsequently made by experts for a later stage where impacts from road operations were considered (Table 10).

Table 10: Negative Environmental Impact Relevance Matrix during Road Operation, According to Expert Team Assessment

NEGATIVE IMPACT RELEVANCE MATRIX													
		STAGE: OPERATING											
ENVIRONMENT FACTORS		MARIA RAQUEL CHAVARRIAS	JACINTO CEDEÑO SÁNCHEZ	FABIO BUITRAGO	NORVING TORRES	RICARDO RUEDA	JOE M.ZOLOTOFF PALLAIS	MILTON CAMACHO	ROAD ENGINEERS	Alteration Value	Maximum Alteration Value	Degree of Alteration
Natural physical factors (sediments, runoff, land use changes, pollution, hydrological regime, geomorphology, air quality)	M1	41	50	58	70	98	96	82	68	563	800	70
Ecological factors (connectivity, scenery, species migration, diversity, abundance, ecosystems)	M2	68	46	76	70	100	96	72	64	592	800	74
Social and economic factors (navigation, fishing, trade, tourism, cost of opportunity)	M3	53	32	52	70	98	93	72	50	520	800	65
Mean Relevance Value		70										
Typical Dispersion		20										
Discrimination Range		90							50			
Alteration Value		162	128	186	210	296	285	226	182	1675		
Maximum Alteration Value		300	300	300	300	300	300	300	300		2400	
Degree of Alteration		54	43	62	70	99	95	75	61			70

For the operational stage the average was 70, which is deemed to have a severe impact relevance (the same as the value for the construction stage). In statistical processing of values assessed by experts, only 4 out of 24 probable values were lower than average minus one standard deviation, and 7 values were above the mean value plus one standard deviation, which indicates a higher value scattering. In this case, 7 values (29%) granted a higher relevance to impact severity during the operational stage, while 54% thought impact at this stage were severe. Matching level was lower.

Both cases indicate expert teams from various disciplines unanimously assessed environmental impacts caused by road construction as severe.

7. EXPERT ASSESSMENT CONCLUSIONS ON DAMAGES CAUSED BY ROAD CONSTRUCTION

1. Historically, Costa Rica has performed actions on the basin that are not compatible with ecosystem capability, leading to irreversible environmental damages on the San Juan River that range from water quality damage, river flow diversion, and biodiversity damages, among others.

2. Road construction without an adequate design, planning, and observance of technical regulations has increased environmental impact severity and damages, directly affecting San Juan River navigability, as well as connectivity of ecosystems making up the Meso-American Biological Corridor and protected areas in both countries.

3. Identified negative environmental impacts from road construction were assessed by experts as severe, and many of them as irreversible, in an area with high environmental sensitivity.

4. Negative environmental impacts expected to arise from road-induced accessibility will irreversibly damage the Indio-Maíz Biological Reserve, San Juan River water quality, aquatic wildlife, river navigability due to silting, as well as the Meso-American Biological Corridor, and consequently the region's protected area system.

5. The road poses hazards to river navigability and flow rate maintenance due to unstable slope cuts that will increase the amount of sediments and decrease water quality.

6. In view of the historical erosion-transport-sedimentation process in the San Juan River channel caused by Costa Rican rivers and now accelerated by road construction, there is a chance the channel will entirely silt up in the medium term, preventing navigation and aquatic wildlife passage, and leaving the town of San Juan de Nicaragua in isolation. A direct consequence will be the loss of a defined borderline between Nicaragua and Costa Rica.

8. RECOMMENDATIONS FOR ENVIRONMENTAL COMMITMENTS AND MITIGATION MEASURES IN VIEW OF DAMAGES CAUSED BY ROAD CONSTRUCTION

1. Since the road was not planned, lacks an Environmental Impact Assessment, exhibits an irregular layout in an area with high environmental fragility and heavy precipitation, and hugs the San Juan River banks tightly, it should be disabled and the environment around road layout should be restored to its baseline conditions, together with a surveillance and monitoring program.

2. Undertaking immediate reforestation on the right banks of the San Juan River at least over a 500-meter strip.

3. Costa Rica should stop impairing its internationally important wetlands declared as Ramsar sites located on Costa Rican territory adjoining the San Juan River.

4. Promoting a negotiation process between the governments of Nicaragua and Costa Rica tending to keep good border relationships between both countries.

5. We suggest both countries should secure the means required for reactivating conservation efforts related to natural resources in the San Juan River sub-basin, given their high vulnerability.

6. Both governments should develop a climate change adaptation strategy, given anticipated threats to the region in different future scenarios, on account of the area's very high precipitation and temperature pattern.

7. It is extremely important the governments of Nicaragua and Costa Rica jointly complete the laying of agreed-upon milestones along the border, thus putting an end to disputes and conflicts between both countries.

8. While the San Juan River is not currently being dredged, Nicaragua sees a stronger need for seriously dredging the river channel in the short term, beginning with a first stretch at the point where the road under construction starts to run parallel to the river and continuing downstream to the Colorado branching. This is in line with the above conclusion, and in view of an uncertain

climate change affecting rainfall frequency and consequently decreasing surface runoff that feeds the river, as well as an accelerated island formation process along the river.

9. With renewed intensity, Nicaragua should continue performing dredging operations on the second stretch of the San Juan River, going from the Colorado branching to the San Juan de Nicaragua lagoon, in order to abate the erosion-transport-sedimentation process exacerbated by the road being built along the river. If Nicaragua does not speed up, deepens, and improves the dredging system, the river will most likely cease to flow on this stretch within ten years (depending on climate change), and as a result Costa Ricans will achieve their cherished aspiration to seize that area of Nicaraguan territory.

The technical document ends here.

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Annex 116

Costa Rican Environmental Management Plan
for the Rafael Mora Porras Road

April 2012

Government of Costa Rica

WE ARE BUILDING
A SAFE COUNTRY

ENVIRONMENTAL MANAGEMENT PLAN

Juan Rafael Mora Porras Road

Ministry of Environment, Energy, and Telecommunications
National Conservation Area System
Ministry of Public Works and Transportation
National Road Council
National Risk Prevention and Emergency Response Commission

April 2012

Table of Contents

1. Introduction

In response to the emergency declaration issued by the Government of the Republic of Costa Rica through Executive Decree N° 36440-MS, declaring the counties of La Cruz, Upala, Los Chiles, Sarapiquí, San Carlos, and Pococí along the border with Nicaragua in a “State of Emergency” in face of the Nicaraguan Army armed invasion of a portion of Costa Rican territory, a decision was made to build a road near the border zone in order to expedite national defense actions, as well as facilitate movements of community members in the northern border area.

This road infrastructure work, like any other, may have caused some environmental impacts on Costa Rica’s national territory. Remedial actions are being and will be taken pursuant to recommendations made by the competent authorities and as part of the activities inherent to the road project, which is still under construction and at a comprehensive improvement stage.

The road under construction is a pioneering infrastructure developed as a result of the special situation warranting its construction. Recent interventions have led to cross-section profile improvements; it has a rolling surface made up of materials from its own natural bed.

The area traversed by the road includes grazing land, scrubs, and pastures supporting cattle ranching, farming, and/or communities or villages where animals have been the main means of transportation, with four-wheel-drive vehicles being used during some periods of the year. Additionally, secondary or primary forest patches are also found.

Impact assessment is limited to: 1) the project area (PA) encompassing the development site, the road infrastructure work and the right-of-way (20 meters); and 2) the direct and indirect influence areas (DIA and IIA), which are the areas that show direct and indirect impacts on the environmental component dynamics caused by the activities to be performed.

This Plan makes an objective technical assessment and proposes recovery and mitigation actions on the environment where impacts might have occurred. This plan does not make a legal evaluation of the project rationale, which, as mentioned above, was driven by the interest of the Republic of Costa Rica to protect its national territorial sovereignty and security.

2. Description of the Area of the Road Construction Project

Costa Rica is located between 8° and 11° North latitude, and between 82° and 85° West longitude geographical coordinates. Including island areas, the country covers 51,100 km² (50,660 km² on land and 440 km² on water). Together with Belize and El Salvador, it is one of the smallest republics in Central America. It borders Nicaragua on the north sharing a border of approximately 309 km, and Panama on the south along approximately 363 km.

The country's biodiversity includes a herpetofauna consisting of some 360 species (150 amphibians and 210 reptiles), approximately 850 bird species (625 nesting and 225 migratory bird species), and almost 205 mammalian species, including bats and non-flying mammals.

Costa Rica has a valuable energy source in its extensive hydrological network, comprised of a large number of rivers flowing to both the Caribbean Sea and the Pacific Ocean. Rivers running to the Caribbean carry a large water volume and are long, navigable, winding, and likely to overflow during the rainy season. On the other hand, and on account of mountain ranges being close to the sea, rivers flowing to the Pacific are short, torrential, and non-navigable.

The project is located in an area that is part of the San Juan River basin, specifically in the Costa Rican sector encompassing northern sub-watershed river basins, which mostly flow into Lake Nicaragua and cover Los Guatusos plains. The other rivers flow to the San Juan River running through San Carlos, Santa Clara, and Tortuguero plains and springing from the Tilarán and Central mountain ranges. The Sapoá and Frío rivers flow into Lake

Nicaragua. The San Carlos River is the largest and longest navigable river in the northern sub-watershed and flows to the San Juan River. The Sarapiquí River is navigable in some stretches and also runs to the San Juan River, as well as the Chirripo River in the northern sub-watershed. Hydromorphic environments in the form of wetlands are particularly found on these plains.

The road building project is located in the country's northern area that includes vast plains stretching from the Guanacaste mountain range to a place known as the Delta, relatively close to the Caribbean Sea although not reaching it. This area with elevations below 500 meters above sea level is known as San Carlos Plains and it has been accessed through the San Carlos River, a tributary of the San Juan River. To the north lies the county of San Carlos and the towns of Upala and Los Chiles, very near the Nicaraguan border. The main two flatlands in this area are San Carlos Plains and Los Guatusos Plains. The aforementioned road has an extension of approximately 160 km from the Delta, where the Colorado River branches off from the San Juan River, to the town of Los Chiles.

Costa Rican geological history dates back to the Tertiary Period when the Limón marine sedimentation took place. Sedimentary processes continued during the Quaternary Period, coupled with volcanic activity in the Central Mountain Range, to form the Caribbean alluvial plains. Costa Rica's Caribbean and northern watershed rivers, particularly the San Carlos and Sarapiquí, typically carry ashes and sediments originating from these volcanoes and other natural events, such as earthquakes.

The project area is made up of disturbed land mostly used for extensive cattle ranching to produce milk and beef and for growing crops in some areas, such as oranges. Forest plantations and recovering forests can also be found under the "environmental service payment" system, together with vegetation usually associated with bodies of water and wetlands in some sectors.

According to an analysis carried out by National Environmental Information Management Center (CENIGA, for its Spanish acronym) of the Ministry of Environment, Energy and Telecommunications (MINAET) in January 2012, using aerial photographs taken in 2005 and provided by the National Geographic Institute, the area clearly shows impacts from agriculture.

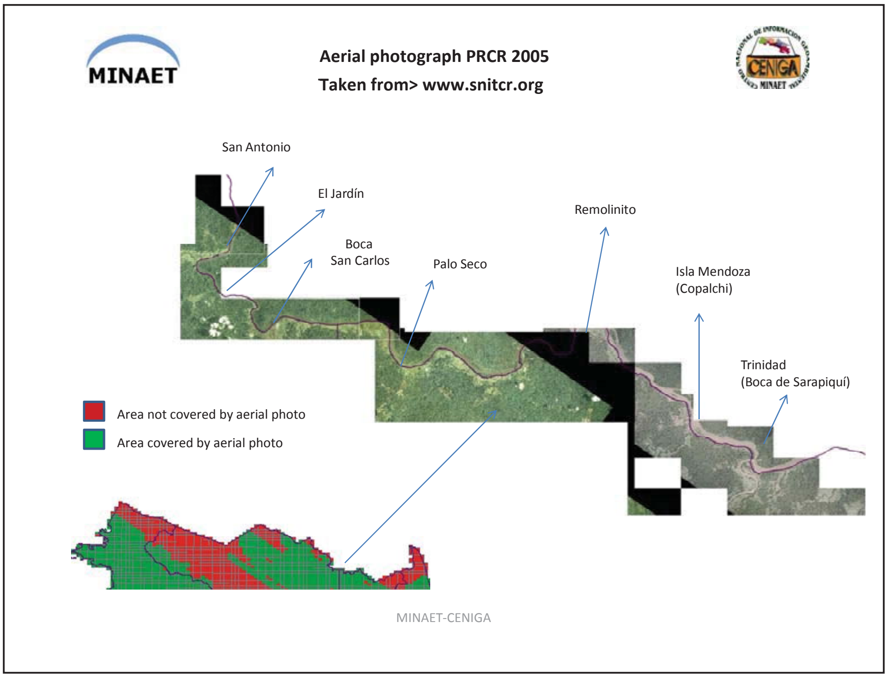


Figure N1 Aerial photograph analysis carried out by CENIGA to identify impacts on the northern border corridor, based on aerial photographs taken in 2005.

As to land relief, the road shows small slope variations and follows a virtually flat terrain. The road stretch between Delta and the Sarapiquí River is a typical plain with no major streams or forests along the project area. The road section from the Sarapiquí to the San Carlos River encounters some forest patches on a slightly more rugged terrain, as well as some wetlands in both the DIA and the IIA. The San Carlos River–Tiricias–Los Chiles section exhibits the most rugged terrain with a stronger presence of water bodies compared to the DIA and the IIA, thus being the area most vulnerable to environmental damage.

3. Impact Assessment

3.1. Methodology

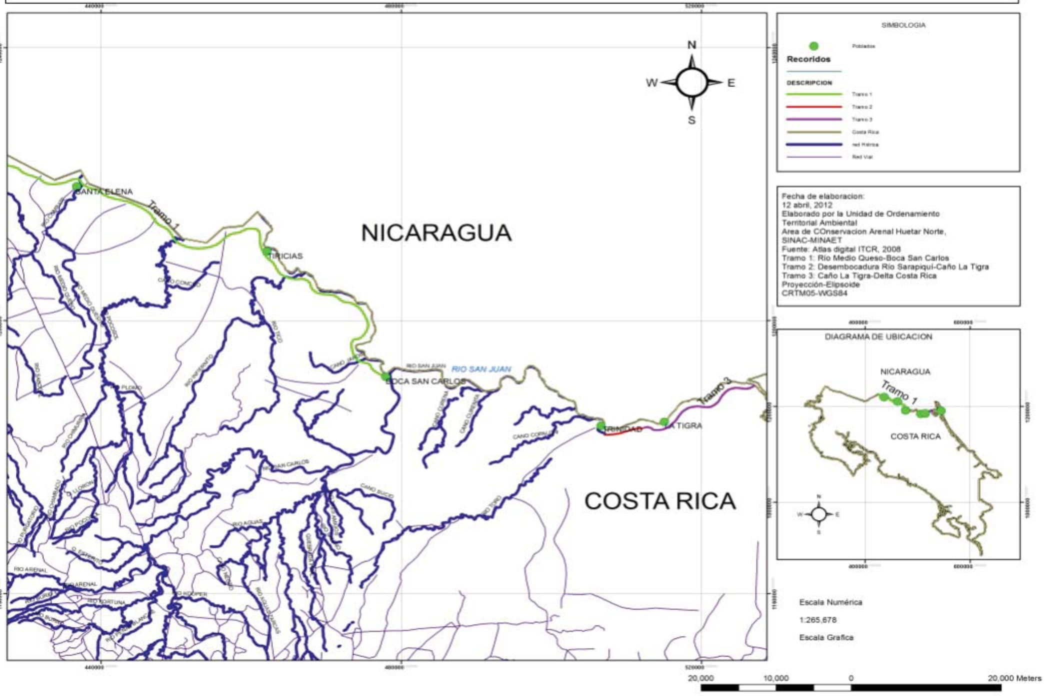
For the purpose of assessing potential environmental impacts caused by road construction, a team was created with officials from the Ministry of Environment, Energy, and Telecommunications (MINAET), which according to Article 5 of Forestry Law N° 7575 is the sector-governing agency responsible for state forest management functions. In addition, pursuant to Articles 32 and 83 of Environment Law N° 7554, MINAET is responsible for managing protected wildlife areas and addressing environmental impacts caused by production processes.

This commission was made up of officials from the Tortuguero (ACTo), Central Volcanic Mountain Range (ACCVC), and Arenal-Huetar Norte (ACA-H) Conservation Areas, as well as the National Environmental Technical Secretariat (SETENA) of MINAET's Geology and Mines Directorate). The composition of this team is shown on Annex 1.

In addition to the assessment made by this team, expert staff from the Ministry of Public Works and Transportation (MOPT) carried out another assessment, the results of which are included in this plan. A visual assessment was made together with expert criteria.

The road was traveled in its entire length identifying sections to be assessed, depending on accessibility and weather conditions, due to the fact that the road was still under construction and some stretches were not yet interconnected. Information was gathered on potentially impacted areas, particularly existing wetlands, water bodies, slopes and terrain cuts. Visits were made to existing mining concessions in the area that have been the source of road building materials, and observations were also made to identify potential impacts on wildlife and plants found along the road under construction and its periphery. As an illustration, the map below shows a preliminary road layout highlighting the assessed road sections.

LOCATION OF GRAVEL ROAD IN NORTHERN COSTA RICAN BORDER CORRIDOR



Digital cameras, GPS, measuring tapes, field notebooks, and other instruments and basic means were used in the assessment, according to each official's assessment goal.

3.2. Environmental Impacts Identified Through Visual Assessment and Expert Criteria

3.2.1. Assessing Impacts on Biodiversity, Ecosystems, and Soils

This assessment was under the responsibility of officials from the National Conservation Area System (ACAHN, ACCVC, ACTo) of the Geology and Mines Directorate and SETENA.

A. Road Stretch from the Medio Queso River to Boca San Carlos

1. Earthmoving works altering the ecosystem and directly or indirectly affecting water dynamics.

2. Wetland ecosystems altered by the construction of drainage ditches and dikes in said areas.

3. Tree removal in some sectors covered by primary and disturbed primary forest, and partial fragmentation of tropical wet and moist tropical forest.

4. Sediment traps under implementation in rainwater drainage canals.

5. Limited soil conservation works to minimize water and soil impacts.

6. Minor changes in the course of some streams.

7. In the Tiricias area there is a quarry that has been used as a source of raw materials for the road. There is also the Molina Quarry, mining concession 46 CNE-2011,

which is currently providing materials. Cuts along the road that could be potential quarries were also found in the same area.

8. The road was traveled going through the town of Boca San Carlos towards a place known as El Jardín, where a quarry with mining concession 156 CNE-2011 is found.

9. Along this stretch the road runs parallel to the San Juan River, which is why its distance from the river should be assessed mostly on account of project integrity.

B. Road Stretch from the mouth of the Sarapiquí River to La Tigra stream located in the county of Sarapiquí in the province of Heredia.

1. The road crosses three streams and a palustrine wetland, all of them flowing to Las Marías stream. Soil alteration signs were observed in these sites. No evidence was found of cloudy or polluted water, or dead animals (fish or other species).

2. Tree removal along road layout. Affected species include tonka bean, oil bean, some wild papaya, hog plum and light virola trees.

3. Silting in palustrine-type wetland mostly covered with grasses (particularly pastures) with a high degree of farmland and forest-free area impairment. No significant sediment transport to the San Juan River was found.

4. Forest disturbance along an approximate 75-meter road stretch. Alterations spread some 15 meters on both sides of the road at the ends of the stretch.

C. Road stretch from La Tigra stream to the area known as Delta Costa Rica

1. Approximately a 3-km long road section was found with trees removed and a slight impact on hydrodynamics of two brooks, although both are still flowing to the San Juan River.

2. Three mining concessions (quarries) requested under Law 8668 by the Sarapiquí Municipality and CONAVI were supervised: 44-CNE-2011 (Chirripó River), 45 CNE-2011 (Puerto Viejo River) and 134 CNE-2011 (Sarapiquí River). No negative mining impacts were found.

3. Extracted materials have been laid down along road sides and on the road itself in a 10-cm thick and up to 12-m wide bed with hand-made sewers. This road section has a flat slope and, hence, no terrain cuts were seen.

4. Materials used at these sites come from the above mentioned mining concessions using a 10-cm thick sub-base, contingent on soil quality, and adding more material at sites with softer soils.

5. One road section has a canal approximately 1.5-m wide and 2-m deep that could carry small amounts of sediments from normal erosion of road and drainage canal walls (pumping) located on both sides of the road.

6. There is evidence this road section was deforested in the past turning the area into pastures for ranching and small-scale agriculture.

7. Road construction machinery is currently traveling between both concession 44 CNE-2011 and Concession 157-92, granted to the El Indio Peasant Settlement Integral Development Association, and the road intersecting the road under construction at a site known as Fátima. Due to an absence of nearby gravel sources this 100-kilometer-plus trip has to be made.

3.2.2. Identifying and Assessing Bodies of Water

This activity was performed by MINAET’s Water Directorate.

A. Approximately 24-km long "Los Chiles Sector" Road Stretch from Medio Queso River Plains to approximately 3 kilometers before the mouth of the Pocosol River.

The bodies of water that were identified and assessed are listed below:

Source Number	Source Type	Coordinates Latitude/Longitude	CRTMOS Latitude/Longitude		Natural Channel	Canal	Natural Depression	Source Criterion
1	River	334341/461138	1219941,14	424719,23	X			Permanent channel
2	Canal	338448/464070	1224044,76	427655,89		X		Not a channel
3	Natural depression	337764/465556	1223359,02	429141,00			X	Not a channel
4	River	337157/466590	1222750,80	430174,23	X			Permanent channel
5	Natural depression	336861/467124	1222454,17	430707,84			X	Not a channel
6	River	336179/473657	1221764,57	437239,61	X			Permanent channel
7	Stream	335489/474031	1221074,14	437612,78	X			Permanent channel
8	Stream	335151/472215	1220738,24	435796,52	X			Channel
9	Stream	334383/475121	1219966,88	438701,43	X			Permanent channel
10	Stream	333855/467317	1219447,91	430897,33	X			Permanent channel
11	Stream	333730/476619	1219312,16	440198,57	X			Permanent channel
12	Stream	333508/477186	1219089,51	440765,27	X			Permanent channel
13	Stream	333094/478171	1218674,39	441749,73	X			Not a channel

14	Natural depression	333041/478318	1218621,21	441896,65			X	Not a channel
15	Stream	332/861/478755	1218620,71	442333,63	X			Channel
16	Channel	332783/478930	1218362,52	442508,32		X		Not a channel
17	Channel	332620/479323	1218199,07	442901,10		X		Not a channel
18	Channel	332444/479735	1218022,59	443312,87		X		Not a channel
19	Stream	332287/480125	1217865,15	443702,66	X			Channel
20	Natural depression	332149/480462	1217726,76	444039,48			X	Not a channel
21	Stream	331956/480901	1217533,27	444478,22	X			Channel
22	Stream	331932/480970	1217509,19	444547,19	X			Permanent channel
23	Stream	331756/481422	1217332,68	444998,95	X			Permanent channel
24	Stream	331628/481741	1217204,31	445317,79	X			Channel
25	Stream	331450/482150	1217025,85	445726,55	X			Permanent channel
26	Natural depression	331275/482564	1216850,38	446140,32			X	Not a channel
27	Natural depression	330878/483223	1216452,63	446798,81			X	Not a channel
28	Natural depression	330674/483421	1216248,41	446996,57			X	Not a channel
29	Natural depression	330048/483995	1215621,76	447569,82			X	Not a channel
Total			1219941,14	424719,23	**17**	**4**	**8**	

B. "Pocosol Sector" road stretch, approximately 4.6-km long, from the area next to Marker 5 to 1 km before Marker 3.

The bodies of water identified and assessed are listed below:

Source Number	Source Type	Coordinates Latitude/Longitude	CRTMOS Latitude/Longitude		Natural Channel	Canal	Natural Depression	Source Criterion
1	River	326096/490429	1211662,55	453998,86	x			Permanent channel
2	River	326581/490915	1212147,01	454485,36	x			Permanent channel
3	Stream	326821/491163	1212386,72	454733,61	x			Permanent channel
4	Stream	327715/492039	1213279,73	455610,54	x			Permanent channel
5	Stream	327906/492212	1213470,53	455783,74	x			Permanent channel
6	Stream	328100/492414	1213664,31	455985,94	x			Permanent channel
7	Stream	328238/492696	1213802,00	456268,06	x			Permanent channel
8	Natural depression	328335/493427	1213898,17	456999,11			x	Not a channel
9	Natural depression	328367/493868	1213929,68	457440,11			x	Not a channel
Total					7		2	

C. "Boca San Carlos Sector" road stretch, approximately 7.3-km long, from Boca San Carlos to Estrecho Machado.

The bodies of water identified and assessed are listed below:

Source Number	Source Type	Coordinates Latitude/Longitude	CRTMOS Latitude/Longitude		Natural Channel	Canal	Natural Depression	Source Criterion
1	Permanent channel	307449/516231	1192987,47	479778,36	x			Permanent channel
2	Stream	307287/516991	1192824,65	480538,12	X			Permanent channel
3	Stream	307247/517478	1192784,13	481025,04	x			Permanent channel
4	Stream	307252/517732	1192788,86	481279,03	x			Permanent channel
5	Stream	307216/518579	1192751,95	482125,92	x			Permanent channel
6	Stream	307258/519108	1192793,38	482654,92	x			Permanent channel
7	Stream	307258/519473	1192792,99	483019,89	x			Permanent channel
8	Stream	307234/519716	1192768,73	483262,85	x			Permanent channel
9	Stream	307383/520497	1192916,89	484043,94	x			Permanent channel
10	Stream	307054/521685	1192586,63	485231,49	x			Permanent channel
Total					10			

D. Road Stretch parallel to the San Juan River from 3 km before the mouth of Caño La Tigra River to 100 m downstream from the Colorado River branch-off.

The bodies of water identified and assessed are listed below:

Source Number	Source Type	Coordinates Latitude/Longitude	CRTMOS Latitude/Longitude		Natural Channel	Canal	Natural Depression	Source Criterion
1	Stream	305268/563047	1190757,13	526588,22	x			Permanent channel
2	Channel	305159/561358	1190649,88	524899,23		x		Not a channel
3	Channel	305170/558753	1190663,58	522294,45		x		Not a channel
4	River	299664/549925	1185166,82	513461,38	x			Permanent channel
Total					2	2		

E. Road stretch approximately 10-km long parallel to the San Juan River from Marker 2 to approximately 1 km before the mouth of the Infiernito River.

The bodies of water identified and assessed are listed below:

Source Number	Source Type	Coordinates Latitude/Longitude	CRTMOS Latitude/Longitude		Natural Channel	Man-Made Drainage	Natural Depression	Source Criterion
1	Laguna	325147/498710	1210704,35	462278,11	x			Permanent channel
2	Natural depression	325141/498889	1210698,15	462457,08			x	Not a channel
3	Artificial drainage	325089/499218	1210645,79	462786,00		x		Not a channel
4	Artificial drainage	324825/499482	1210381,50	463049,68		x		Not a channel
5	Stream	324226/499556	1209782,43	463123,02	x			Permanent channel
6	Natural depression	324111/499567	1209667,42	463133,89			x	Not a channel
7	Artificial drainage	323862/499646	1209418,33	463212,60		x		Not a channel
8	Stream	323553/499777	1209109,19	463343,26	x			Permanent channel
9	Artificial drainage	323167/499979	917923,29	463262,23		x		Not a channel
10	Natural depression	323084/500106	1208639,84	463671,71			x	Not a channel
11	Stream	322866/500257	1208421,68	463822,45	x			Permanent channel
12	Artificial drainage	322614/500455	1208169,46	464020,16		x		Not a channel

13	Natural depression	322062/500658	1207617,24	464222,54			x	Not a channel
14	Artificial drainage	321971/500786	1207526,10	464350,43		x		Not a channel
15	Artificial drainage	321845/500885	1207400,00	464449,27		x		Not a channel
16	Artificial drainage	325341/498058	1210899,07	461626,38		x		Not a channel
17	River	325981/497649	1211539,51	461218,13	x			Permanent channel
18	Natural depression	326179/497810	1211737,33	461379,33			x	Not a channel
19	Stream	328501/498470	1214058,55	462041,85	x			Permanent channel
20	Artificial drainage	328724/498348	1214281,68	461920,11		x		Not a channel
21	Natural depression	329175/498079	1214732,98	461651,63			x	Not a channel
22	Artificial drainage	329364/497913	1214922,15	461485,86		x		Not a channel
23	Artificial drainage	329484/497808	1215042,28	461381,00		x		Not a channel
24	Natural depression	329628/497751	1215186,33	461324,17			x	Not a channel
25	Stream	329831/497435	1215389,68	461008,42	x			Permanent channel
Total					7	11	7	

A total of 43 creeks, 17 natural depressions, 11 man-made drainages, and 6 canals were identified in all inspected road stretches.

3.3 Summarized Impacts and Recommended Environmental Measures

3.3.1. WATER RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Local impact from moderate sedimentation in waterbodies as a result of surface runoff during construction processes.
2. Small pollution foci in some bodies of water due to carried solid (excavated materials and others) and liquid waste from construction processes, such as lubricants and hydrocarbons.
3. Removed and altered vegetation cover, mainly in already disturbed sectors.
4. Early-stage decrease in hydraulic capacity on account of sediments clogging waterbodies, some of them unimportant.
5. No sediment deposition was observed in the San Juan River, although small amounts of sediments may be carried by rain or some streams flowing into the river within this ecosystem normal dynamics.

PROPOSED AND ONGOING ENVIRONMENTAL MEASURES

1. Building road cross-cutting drainages through the Medio Queso wetland to partially restore natural flow and direction of water running parallel to both banks of the Medio Queso River.
2. Plantations with native local species should be established to protect river and brook banks, particularly in areas without any forest cover, on the entire land strip between the road and the San Juan River.
3. Hydrological studies should be made for all water crossings to determine design flow rates in order to identify required hydraulic works capacities.
4. To the extent possible, keeping natural waterbody hydraulic sections at the time of hydraulic works installation and providing inlet and outlet structures to facilitate channel flow transition to and from the structure to be installed.

5. For crossings over some brooks, a channel maintenance plan should be developed (channel cleaning to remove accumulated sediments).
6. Establishing fully-equipped weather and hydrological stations. The Weather Institute and Electricity Institute should be involved in the decision-making process for evaluating sites and determining the required station type.
7. Protecting the natural vegetation cover existing between road layout, bridges, or drainage structures and bodies of water.
8. Installing sediment traps in some of the identified sites to prevent sediments from leaving work areas and reaching nearby bodies of water. Traps may be built with metal structures and geotextiles or other filtering media. (See Annex on the recommended waterbody works matrix).
9. Establishing slope-foot protective gutters draining towards sediment traps.
10. Areas for materials disposal should be far enough from bodies of water to make sure flood water level will never be above the lowest level of disposed materials.
11. Dumping excavated or cut materials downhill into rivers and brooks is prohibited.
12. Care should be taken when working on national rivers or river banks to make sure no oil or fuel leaks may reach bodies of water.
13. Machinery washing and maintenance tasks in streams will be prohibited.
14. Designating and preparing a construction waste and debris disposal site. All organic waste materials from clear-cutting or site preparation should be piled on the disposal site away from waterbodies to be finally taken to the nearest dump approved for such purpose.
15. In case worker camps are established, septic tanks may be used to receive regular sewage water. These tanks should be designed according to soil permeability characteristics making sure local aquifers will not be affected. Otherwise, sanitary cabins should be used for regular sewage water.
16. Construction of temporary or permanent hydraulic works should not alter or change a waterbody natural channel, to the extent possible.
17. Design of the different planned hydraulic works should be respected in order to make sure all outgoing water drains in the same direction as the incoming stream to thus prevent slope erosion. (See Annex 2, Recommended Works by Source Type)

3.3.2 FOREST AND WILDLIFE RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Removal and alteration of vegetation cover.

2. Use of uprooted tree trunks as crossings over brooks and streams.

3. Increased demand for natural resources, plant and wildlife extraction.

4. Possible wildlife displacement route alteration.

5. Risk of wildlife being run over by vehicle traffic.

PROPOSED ENVIRONMENTAL MEASURES

1. Recover disturbed areas through natural regeneration or reforestation.
2. Build road crossings for animals and installing speed bumps.
3. Install preventive vertical signs to warn about wildlife presence.
4. All staff involved in the project should be required to abide by the ban on wildlife trade, extraction or hunting, even on holidays, rest days and/or Sundays.
5. Close monitoring by competent authorities (Prevention, Control, and Protection Brigades) to prevent plant and wildlife extraction and transfer.
6. Gather local volunteer teams (COVIRENAS) that advocate natural resource protection and provide support to control and protection activities.
7. Construction of bridges over brooks or rivers to deter use of woods from nearby forests.

8. On sites where isolated trees were removed to build the road, and if conditions allow it, native tree species should be planted to replace them.

3.3.3 SOIL RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. In some sectors, no soil conservation works were implemented to minimize local water and soil impacts.
2. Soil structure was modified during the construction process.
3. Potential increase in focused erosion processes.
4. Potential instability in some slopes.

PROPOSED ENVIRONMENTAL MEASURES

1. Placing sediment retaining structures (sediment traps) on gutters.
2. Implementing a drainage system maintenance program to prevent drainage clogging.
3. When surplus material has been laid on the roadside, it should be removed and taken to previously established sites designated for this purpose.
4. Keeping quarry concessions in force; in case their term expires, a technical closure study should be carried out. Quarry mining methods should be periodically monitored.
5. Preventing fuel, oil, or chemical spills in general. In addition, water-proofing vulnerable areas to prevent filtrations into the soil, such as in chemical warehouses and/or fuel handling sites. Tools should be available to clean up potential spills.
6. Excavations and fills will be made only in the road project area and authorized nearby areas.
7. Drainages should be installed as soon as possible before placing the fills to prevent excess moisture and reduce erosion.
8. Non-usable materials, such as organic soil, should be disposed of in specifically designated sites.

9. Surplus materials should be removed in coordination with excavation progress to reduce material runoff.
10. Excavations should remain uncovered the shortest time possible, particularly in sectors with unconsolidated soils or those requiring drainage or runoff control systems.
11. Slopes should have safe and stable gradients.
12. In cases where slopes devoid of vegetation are created, complementary slope-stabilizing measures should be taken, such as low-growing vegetation (vetiver), banking, gabions, geotextiles or other containment structures.

3.3.4 AIR RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Noise generation that could impact wildlife.

2. Gas and particulate matter emissions to the atmosphere in undetermined volumes.

PROPOSED ENVIRONMENTAL MEASURES

1. Require contractors to use machinery in good operating conditions and with vehicle technical inspection certificate still in force, in such a way the smallest possible amounts of gases and particulate matter are emitted during fuel burning.

2. Use machinery that meets sound levels established in current regulations.

3. Regulate speed of dump trucks in work areas and require them to cover dump truck beds with a tarp to prevent materials from falling.

4. Irrigate periodically depending on wind and solar radiation conditions, in addition to preventing potential nuisance to third parties (nearby homes, schools, farmland, and others).

5. Store fine-grained materials under appropriate conditions to protect them from wind or rain.

3.3.5 SOLID AND LIQUID WASTE MANAGEMENT

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Risk of potential impacts on wildlife and plants.

2. Risk of potential impacts on bodies of water.

3. Risk of potential impacts on soils.

4. Risk of potential impacts on population centers and others.

5. Risk of potential pollution from liquid waste generation.

PROPOSED ENVIRONMENTAL MEASURES

1. Dump sites for disposing of debris from cuts and clear-cutting and cleaning operations should be authorized by their owners and by the competent authority, in addition to meeting relevant guidelines. By and large, they should meet the following conditions:

   - Prevent impacts on forest stands or waterbodies.
   - Preferably consisting of natural depressions, in such way that they will level off after filling.

- Prevent obstruction of watercourses and maintaining minimum setback regulation, if located near a water body.
- Stable (without evidence of active slide scarring or other significant erosion processes).
- Prevent impacts on population centers or wetlands.
- Authorized dump sites.

2. In order to minimize required dump size, the project should reuse stony materials resulting from right-of-way excavations.

3. The requirements established by the Ministry of Health and/or local municipality, as appropriate, should be met.

4. Normal solid waste generated by staff using temporary facilities and work areas should be collected at the generation point and disposed of in authorized sites (municipal dumps, authorized landfills).

5. Where practicable and economically feasible, the following solid waste management hierarchy should be put into practice: reduction at the source, reuse, recycle, and disposal.

6. Separate containers should be made available to collect special waste (such as oils and lubricants). Staff should be trained on how to recognize and sort them, and specifically authorized disposal means should be used. The use of personal protective equipment should be mandatory.

7. Solid waste transportation vehicles should be equipped in such way as to prevent leachate or waste drippings or dispersion along the route. They should also be frequently washed and sanitized to prevent foul smells.

8. Employee camps or housing areas should have adequate liquid waste management devices, either septic tanks or sanitary cabins, to meet workers' needs according to current regulations (one per 20 workers).

3.3.6 HISTORICAL AND ARCHAEOLOGICAL HERITAGE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Impacts on potential archaeological discoveries.

PROPOSED MEASURES

National regulations concerning archaeological discoveries should be observed, namely, if archaeological remains are found during excavations all work in the area should be stopped, and the Costa Rican National Museum and/or the archaeologist in charge should be informed at once. Recommendations issued by the Museum or a professional on the matter should then be followed.

3.3.7 SOCIOECONOMIC RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Increased agricultural and commercial activities, and more human settlements.

PROPOSED ENVIRONMENTAL MEASURES

1. A socioeconomic study should be carried out as soon as possible to identify the potential impact generated by the road construction. At the same time, information should be collected to develop suitable tools to minimize the risk of shantytowns and

illegally purchased land for building infrastructure that could impact forest areas or wetlands.

2. A land property study should be carried out within the Costa Rica-Nicaragua Corridor Wildlife Refuge, where buildings exist and agricultural, ranching and other production activities are being carried out, indicating the existence of some kind of possession and/or occupation.

3. Work should be carried out with the people living in the site through rural outreach processes, in order to improve their livelihoods, while instilling among them a sense of ownership to become involved in site mitigation and restoration actions.

Annex 3 shows a summarized action plan, including the names of the persons in charge and the terms or deadlines for implementing the main recommended measures.

4. References

1. **Ministry of Public Works and Transportation. Sector Planning Unit. Environmental and Social Management Unit.** January 2012. *PLAN REMEDIAL DE MEDIDAS AMBIENTALES DE MITIGACIÓN, PREVENCION Y/O COMPENSACION POR CONSTRUCCION Y MEJORAMIENTO RUTA PARALELA A LA LINEA FRONTERIZA COSTA RICA-NICARAGUA.*
2. **Ministry of Environment, Energy, and Telecommunications.** February 2012. *INFORME DE VALORACIÓN AMBIENTAL Y MEDIDAS DE REMEDIACIÓN CORREDOR FRONTERIZO*. Compiled by engineer Alba Iris Ramírez and based on reports developed by an expert commission from SINAC, the Water Directorate, SETENA and the Geology and Mines Directorate.

Annex 1 Members of the Institutional Commission

COMMISSION	
Agency	**Name of Official**
National Conservation Areas System (SINAC), Executive Secretariat (ES)	Randall Campos
SINAC, Huetar Norte Conservation Area (ACAHN)	Carlos Ulate R.
SINAC, Central Volcanic Mountain Range (ACCVC)	Jose Luis Agüero
SINAC, Tortuguero Conservation Area (ACTo)	Erick Herrera Quesada
National Institute of Meteorology (IMN)	Mauricio Ortiz Monge
Water Authority	Álvaro Porras Vega
	José Joaquín Chacón
	Nancy Quesada
	Andrea Barrantes
Geology and Mines Directorate	Luis Alberto Chavarría, Esteban Bonilla y Alberto Vazques
National Environmental Technical Secretariat (SETENA)	Manuel Céspedes
	Carlos Camacho
Ministry of Public Works and Transportation (MOPT)	Giselle Alfaro

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

	Source	Location		Recommended Works	Priority
		Latitude	Longitude		
Report AT-0102-2012, from marker 1, latitude coordinate: 330.447 and longitude coordinate: 496.953 to approximately 1 km before the mouth of the Infiernito River, latitude coordinate: 321.635 and longitude coordinate: 501.461	1	325.147	498.710	Drain overpath, sediment traps	
	5	324.226	499.556	Drain crossing or bridge, sediment traps, entrance and exit structures	
	8	323.553	499.777	Drain crossing or bridge, sediment traps, entrance and exit structures	
	11	322.866	500.257	Drain crossing or bridge, sediment traps, entrance and exit structures, energy dissipator.	
	17	325.981	497.649	Bridge, sediment traps	
	19	328.501	498.470	Drain crossing, sediment traps	
	25	329.831	497.435	Drain crossing or bridge, sediment traps, entrance and exit structures	
Report DA-0173-2012, from the plains of the Medio Queso River, latitude coordinate: 334.543 and longitude coordinate: 460.560 up to Estrecho Machado, latitude coordinate: 307054 and longitude coordinate: 521685	1	334.341	461.138	Should be analyzed with the respective SINAC since the area under study corresponds to wetlands	
	4	337.157	466.590	drain overpass or bridge, energy dissipators, sediment traps	
	6	336.179	473.657	Bridge, sediment traps	
	7	335.489	474.031	Drain crossing, sediment traps	
	8	335.151	472.215	Drain crossing, sediment traps	
	9	334.383	475.121	Drain crossing, sediment traps	
	10	333.855	467.317	Drain crossing, sediment traps	
	11	333.730	476.619	Drain crossing, sediment traps	
	12	333.508	477.186	Drain crossing, sediment traps	
	13	333.094	478.171	Drain crossing, sediment traps	
	15	332.861	478.755	Drain crossing, sediment traps	
	19	332.287	480.125	Drain crossing, sediment traps	
	21	331.956	480.901	Drain crossing, sediment traps	
	22	331.932	480.97	Drain crossing, sediment traps, energy dissipators	
	23	331.756	481.422	Drain crossing, sediment traps, energy dissipators	
	24	331.628	481.741	Drain crossing, sediment traps, energy dissipators	
	25	331.45	482.15	Drain crossing, sediment traps, energy dissipators	
	1	326.096	490.429	Drain crossing or bridge, sediment traps	
	2	326.581	490.915	Drain crossing or bridge, sediment traps	
	3	326.821	491.163	Drain crossing, sediment traps, energy dissipator	
	4	327.715	492.039	Drain crossing, sediment trap	
	5	327.906	492.212	Drain crossing, sediment trap	
	6	328.1	492.414	Drain crossing, sediment trap	
	7	328.238	492.696	Drain crossing or bridge, sediment traps	
	1	307.449	516.231	Drain crossing, sediment traps, energy dissipators	
	2	307.287	516.991	Drain crossing, sediment traps, energy dissipators	
	3	307.247	517.478	Drain crossing, sediment traps, energy dissipators	
	4	307.252	517.732	Drain crossing, sediment traps	
	5	307.216	518.579	Drain crossing, sediment traps, energy dissipators	

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

	Source	Location		Recommended Works	Priority
		Latitude	Longitude		
	6	307.258	519.108	Drain crossing, sediment traps, energy dissipators	(red)
	7	307.258	519.473	Drain crossing, sediment traps	(yellow)
	8	307.234	519.716	Drain crossing, sediment traps	(yellow)
	9	307.383	520.497	Drain crossing, sediment traps	(yellow)
	10	307.054	521.685	Drain crossing, sediment traps, energy dissipators	(red)
Report DA-0171-2012, from 3 kms before the mouth of the Caño La Tigra River, latitude coordinate: 299.441, and longitude coordinate: 546.835, up to 100 meters downstream from the headwaters of the Colorado River at latitude coordinate: 305.268, and longitude coordinate: 563.047	1	305.268	563.047	It is not recommended to build hydraulic works (bridges, canals) that give access to the zone located southeast of the right bank of the Colorado River because such works correspond to wetland areas.	(green)
	4	299.664	549.925	Bridge, entrance and exit structures, sediment traps	(red)

1. This will be conditioned by current hydraulic and hydrological characteristics for which no information is available, so hydrological and hydraulic studies to perform should consider installing structures, such as energy dissipators, which could cause erosion according to the works to perform.
2. This reommendation is based on field observations, flow of source, observed sedimentation, observed topography.
3. The number of drain crossings will depend on the design.
4. With respect to sediment traps, the installation of at least one is recommended.
5. Green, yellow and red priorities are based on the risk that sediments could be transported by the channels located on Costa Rican soil to the San Juan River channel due to its proximity and to the exposure of sediments in the channels and on the road.
6. Sources not determined as public domain are not being considered.
7. The numbering of sources is the same used to identify them in the respective reports.

Interpretation of previous matrix: The tables are divided in three sections, depending on the reports issued by this Directorate (AT-0102-2012, DA-0173-2012 and DA-0171-2012).
The main mitigation works recommended are:
Adequate drain crossings or bridges according to the hydraulic and hydrological characteristics of the site, endeavoring to maintain hydraulic sections of sources, in order to reduce downstream and upstream impact by the structures to implement, preventing any impact resulting from water and debris accummulation that could cause flooding in the zone due to overflowing on both sides of the banks during high precipitation periods.
The entrance and exit works seek to facilitate drainage of water flowing from the channel to the structure to install, or vice versa, thus reducing the impact resulting from erosion in transition sections.
Energy dissipators seek to mitigate the impact by reducing speed of the flow that could be erosive. This permits to minimize transportation of sediments from the channels to the San Juan River, for which sediment traps have been recommended.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
	1. Areas within the Medio Queso River wetlands are affected by the road construction.	Transversal road crossings within the Medio Queso River wetlands.	CONAVI, Water Directorate and ACHN	Second quarter of 2012	
		Conduct study to determine current characteristics of superficial hydric system, including wetlands, in order to identify potential impacts on the hydric system in the intervened area that are not yet visible.	Water Directorate with support from Superior Education Institutions	Second quarter of 2013	
	2. Drainage canals and dikes in wetland areasare altering the ecosystem.	Analyze conditions of the affected wetlands, assess degree of damage and propose recovery measures.	Executive Secretariat and ACHN, SINAC	Second quarter of 2012	A recovery plan should be established for the affected wetlands.
	3. Earth movements directly or indirectly affect hydric resources.	Transversal slopes in sites where land cuts are more than 3 meters high to avoid landslides.	CONAVI	Second quarter of 2012	
		Place mesh over slopes to avoid landslides and plant vetiver grass on the side of the slope.	CONAVI, SINAC	Third quarter of 2012	Seed suppliers should be sought to plant Vetiver grass.
		In the event surplus material has been deposited on the side of the road, it should be removed and transferred to sites previously established for this purpose.	CONAVI	Second quarter of 2012	This activity should be executed as the road construction advances.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
From Medio Queso River (Latitude: 334.543 and Longitude: 460.560) up to Boca San Carlos (Latitude: 307430 and Longitude: 515029).	4. Elimination of primary forest and intervened forest and fragmentation of humid and very humid tropical forest.	Identification of sites where the forest was eliminated and fragmented.	SINAC	Third and fourth quarter of 2012	Map the affected areas.
		Plant native trees (Almond, Chilamate, Ceibo, Titor, Javillo and Sotacaballo) to replace the trees that were eliminated by the road construction.	SINAC	Second quarter of 2012	Identify potential sites and responsible institutions in the zone where trees can be produced (schools, tele-secondary schools, agricultural centers, women groups), which could be planted in agro-forestry, forest grazing and windbreaker systems.
		Implement payment of environmental services in those farms that comply with all requirements established for this purpose.	SINAC	Third quarter of 2012	Identify affected farm owners and establish priorities (economic condition and size of the affected area).
		Monitor the proposed activities.	SINAC	Third quarter of 2012	
	5. Stormwater canals without sediment traps .	Sediment traps with rainwater speed reducers should be built in those sites where sediments accumulate in the stream crossing canals and subsequently should be cleaned.	CONAVI	Second to fourth quarter of 2012	
	6. Absence of soil conservations works to minimize impact on hydric and edaphic resource.	Reduce soil loss with conservation works	MAG	Second to fourth quarter of 2012	In view that farms have already been established in the Border Corridor, it is necessary to work on a soil management and conservation program in coordination with the Ministry of Agriculture and Livestock.
		Provide training on soil use and conservation targeted to farmers in the zone.	MAG	Second to fourth quarter of 2012	

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
		Perform engineering and geological assessment that permits to ensure the stability and permanence of the works already initiated.	CONAVI	Second quarter of 2013	
	7. Change of stream courses.				No mitigation measures were presented.
		Recovery of affected area by planting native species that produce colorful flowers (Tabebuia chrysantha, tabebuia rosea, among others).	SINAC	First quarter of 2013	This areas should be protected to prevent ingress of animals or machinery into the site, which could damage the zone under recovery.
		Site recovery through natural regeneration.	SINAC	First quarter of 2013	These areas should be protected to prevent ingress of animals or machinery to the site, which could damage the zone under recovery.
	9. Wildlife affected by road construction parallel to the San Juan River.	Animal crossing signage and installation of speed reducers.	CONAVI, SINAC	Second quarter of 2012	
		Surveillance by competent authorities to prevent wildlife extraction and transfer	SINAC	Year-round	
		Form local voluntary groups (COVIRENAS) engaged in resource protection and supporting control and protection activities.	SINAC	Third quarter of 2012	Train COVIRENAS groups on technical and legal aspects (Wildlife Law, Forestry and Biodiversity Law, soil conservation)
		Perform biological diagnose to identify environmental fragility (flora and fauna) of the intervened area.	SINAC with support from superior education institutions.	First quarter of 2013	Take advantage of interagency agreements to carry out this work.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
	10. Increased agricultural, and commercial activities and human settlements.	Prepare socioeconomic diagnose to identify ponential impact generated by the road construction.	SINAC with support from superior education institutions	First quarter of 2013	Take advantage of existing interagency agreements to carry out this work.
		Prepare the respective archeological studies.	CONAVI in coordination with the National Museum.	Third quarter of 2013	
		Carry out a study of land tenancy given that land use has changed on state lands where agriculture, livestock and other productive tasks are performed.	SINAC with support from superior education institutions.	Third quarter of 2013	
	1. Sediment accummulation in stream canals.	Construction of sediment traps	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive.
		Rainwater speed reducers	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive.
		Cleaning of sediment traps	CONAVI	Second and third quarter of 2012	Esta actividad se recomienda hacerla cuando las condiciones de lluvia son menores
		Monitoring the proposed activities	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive.
	2. Land cuts.	Build transversal slopes to avoid landslides	CONAVI	Second quarter of 2012	
		Place mesh over slopes to prevent landslides.	CONAVI	Third quarter of 2012	
		Collect surplus material deposited on the side of the road.	CONAVI	Second quarter of 2012	
		Plant vetiver grass on the edge of the slope.	CONAVI, SINAC	Third quarter of 2012	
		Monitor the proposed activities.	SINAC	Second and third quarter of 2012	

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
From the outlet of the Sarapiquí River to the outlet of the Caño La Tigra River located in the Sarapiquí canton in the Province of Heredia.		Establish measures for good management of material extraction sites and assess possible closure once the work is concluded.	CONAVI	First quarter of 2013	
	3. Obstruction of stream crossings.	Carry out hydrological studies to determine the respective design flows in each water passage, with the objective of establishing the necessary capacity in the sewer systems to be installed.	Water Directorate	Second quarter of 2012	
		Install concrete tubes in stream crossings in the three identified points.	CONAVI	Second quarter of 2012	
		Clean stream canals to eliminate sediments.	CONAVI	Second quarter of 2012	
		Monitor the proposed activities.	Water Directorate	Second quarter of 2012	
	4. **Uprooting or felling of trees.**	Plant native trees (Almond, Chilamate, Ceibo, Titor, Javillo and Sotacaballo) to replace trees eliminated by the road construction.	SINAC	Second quarter of 2012	Identify potential sites and responsible institutions in the zone where trees can be produced (schools, tele-secondary schools, agricultural centers, women groups). Trees could be plaed in agro-forestry, forest grazing and windbreaker systems.
		Monitor the proposed activities.	SINAC	Third quarter of 2012	
		Analyze the conditions of the affected wetland, assess the degree of impact, and propose recovery measures.	Executive Secretariat and ACHN, SINAC	Second quarter of 2012	Recovery plan should be established for the affected wetlands.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
	5. Wetlands affected by sediments.	Construction of sediment traps.			It is recommended to carry out this activity when rain conditions are less intensive.
		Rainwater speed reducers			It is recommended to carry out this activity when rain conditions are less intensive.
		Cleaning of sediment traps			It is recommended to carry out this activity when rain conditions are less intensive.
		Monitoring the proposed activities			It is recommended to carry out this activity when rain conditions are less intensive.
	1. Affectation in two streams and forest areas.	Eliminate wooden beam bridge that was built for passage of machinery and build a mound of rock and sand to avoid ingress of vehicles to the site.	SINAC	Second quarter of 2012	The construction of hydraulic works (bridges, canals) that give access to the zone located southeast of the right bank of the Colorado River is not recommended, specifically in source 1 (coordinates latitude 305268, longitude 563047) because this zone corresponds to wetland areas.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856					
Road Stretch	**Identified Environmental Impact**	**Proposed Mitigation Action**	**Executing Unit**	**Date**	**Observations and/or considerations**
From 3 kms before the outlet of the Caño La Tigra River (Coord. Latitude: 299.441 and Longitude: 546.835) up to 100 meters downstream from the headwaters of the Colorado River (Coord. Latitude: 305.268 and Longitude: 563.047):		Foster natural regeneration in the affected forest areas and plant native trees (Almond, Chilamate, Ceibo, Titor, Javillo and Sotacaballo), especially in the slopes of the streams and canals built.	SINAC	Second quarter of 2012	
		Increase surveillance in the zone by establishing prevention, control and protection brigades, with the objective of controlling ingress to this road area.	SINAC	Second quarter of 2012	
	2. Sediment accummulation in stream channels.	Construction of sediment traps.	CONAVI	First and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive
		Rainwater speed reducers.	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive
		Cleaning of sediment catchment traps.	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive
		Monitoring the proposed activities.	CONAVI	Second and third quarter of 2012	It is recommended to carry out this activity when rain conditions are less intensive
	3. Canals on both sides of the road, one of which drains directly into the San Juan River.	Perform support works for maintenance of canals by periodically cleaning and extracting sediments.	CONAVI		

Annex 117

Association of Federated Engineers and Architects of Costa Rica
(CFIA Report)

8 June 2012

Association of Federated Engineers
and Architects of Costa Rica
(CFIA, by its Spanish acronym)

Procedures Department
Inspection & Standards Div.
Tel. (506) 2202-3928
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P.O. Box 2346-1000

Report: DRD-INSP-0299-2012
8 June 2012

Requested by	:	Board of Directors, CFIA Executive Directorate, CFIA
Reason for Inspection	:	Verification of work done toward the construction of "Juan Rafael Mora Route 1856"
Location of the project	:	Border road, northern area parallel to the Río San Juan
Inspectors assigned	:	Engineer Francisco J. Reyes Cordero Engineer Austin Shen Ti Engineer Luis Diego Alfaro Artavia Engineer Alexander Guerra Morán Engineer Luis Castro Boschini Architect Marielos Alfaro Herra Architect Carlos Murillo Gómez

PRELIMINARY REPORT

1. Background

1.1 This investigation was carried out as instructed by the Board of Directors of the Association of Federated Engineers and Architects of Costa Rica (CFIA, by its Spanish acronym), through Engineer OlmanVargas Zeledón, CFIA Executive Director, for the purpose of determining progress of the project and to evaluate the construction of the border road.

1.2 Prior to the field trip, on 24 May 2012 a meeting was held among the professional team involved in the project. This was part of the investigation by the CFIA being done under an inspection file opened under No. 92-12.

1.3 At the meeting mentioned in paragraph 1.2, we were provided with maps of the route the border road is to follow and its different means of access. Route 1856 extends along the approximately 160 kilometres between Los Chiles and Delta (in front of Isla Calero) and the arteries that access it, which total approximately 400 additional kilometres. Another observation is that due to the absence of bridges that would interconnect the route at different routes, (including the mouths of the Sarapiqui, San Carlos and Pocosol Rivers) for the time being it is impossible to travel the route without interruption. Also, there are different points in different stretches where work has not been started. Records at the CFIA also reflect that there are no plans or preliminary studies for the project, and the process of register the project under CFIA responsibility was never initiated.

1.4 The visit was done by Inspectors Alexander Guerra Morán; Francisco Reyes Cordero; Austin Shen Ti, of the Central Office; and Luis Diego Alfaro Artavia, of the Northern Regional Office, all of them engineers; together with the Chief of CFIA Procedures Dept. Architect Carlos Murillo Gómez.

1.5 On 7 June 2012, a second visit was done by Inspectors Luis Castro Boschini, from the Central Office; Luis Diego Alfaro Artavia from the Northern Regional Office; and Architect Marielos Alfaro Herra, of the Northern Regional Office Coordinating Committee.

2. Objective and scope

Verification of work done toward the construction of "Juan Rafael Mora Route 1856."

The investigation consists of on-site inspection carried out in conformity with present legislation whose guidelines were used in this document.

As a result of the scope and the methodology employed, this report is a preliminary study of conditions observed at the time of the visit. It is part of Inspection File 92-12 open by the Procedures Dept.

3. GENERAL ASPECTS

Present status and condition regarding drainage and possible environmental damage, recesses of rivers and streams, the excavation and stabilization of slopes were inspected.

4. RESULTS OF THE INSPECTION

Inspections of the area located in Heredia Province; Sarapiquí District; as well as Alajuela Province, San Carlos District; took place on 24 and 25 May, and later on 7 June 2012.

4.1 Observations made in the above area: The following stretches of the road were inspected:

4.1.1 Arteries that access route 1856:

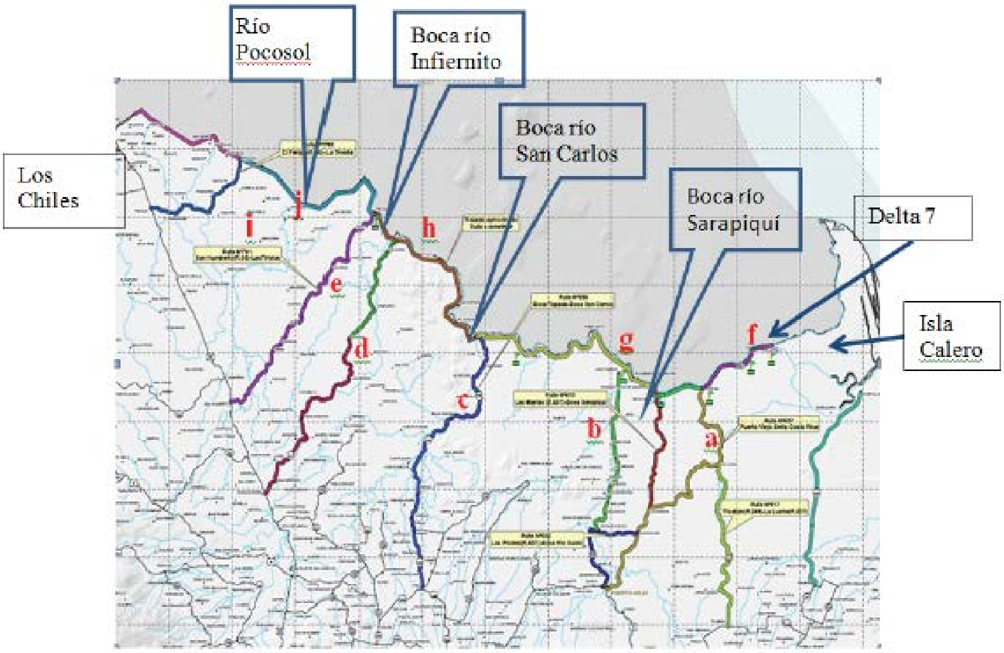
a) Puerto Viejo – Fátima route
b) Boca Río Sucio – Caño Tambor hillside route
c) Boca Tapada – Boca San Carlos route
d) Buenos Aires – Moravia – Crucitas
e) San Humberto – Las Tiricias route
i) Parque – La Trocha, Route 760

4.1.2 Route 1856:

f) Delta 7 – Fátima – Boca Ceiba (mouth of the Río Sarapiquí)
g) Caño Tambor – Remolinito – Palo Seco – Boca San Carlos (from Boca Sarapiquí to Boca San Carlos).
h) 15 kilometers in the zone near Tiricias (Tiricias Road)
i) 23 kilometers – border post toward the east along the Tiricias Road.
j) 5 kilometers – border post toward the west along the Los Chiles Road.

Diagram No. 1

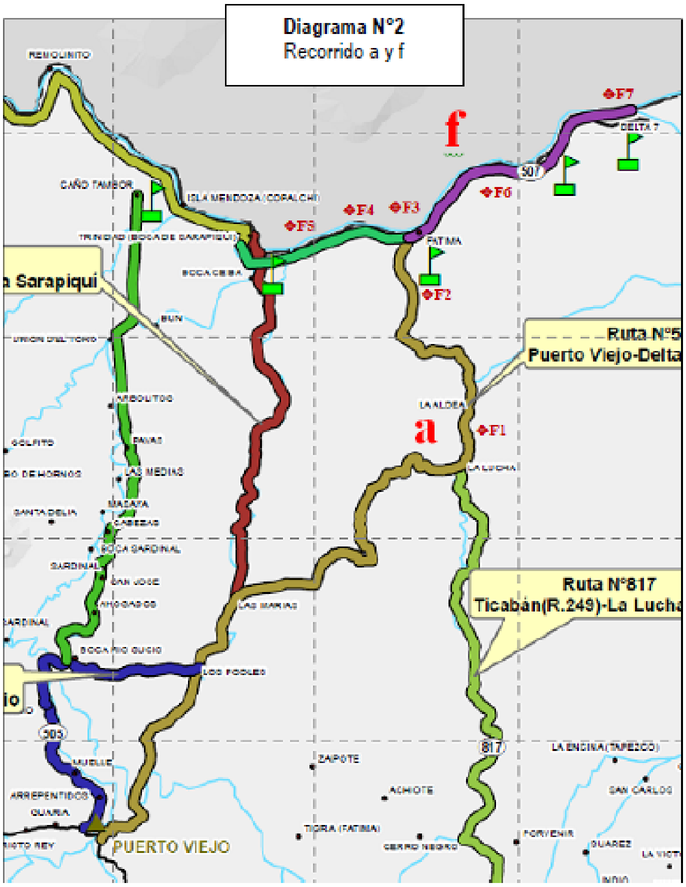
Juan Rafael Mora Route 1856 and arteries that access it:



Km 0, Delta 7, Costa Rica

Diagram No. 2

Visit (a) and (f)



a) Puerto Viejo – Fátima route

- This route already exists; it seems that the intent is to rehabilitate it.
- During the visit we were able to see that the route is comprised of gravel with a great number of cracks and holes.
- Parts of the road have no drainage slopes or ditches, therefore, water accumulates in those areas. Parts of the road with drainage require uniformity and maintenance.
- An abandoned trailer container was observed on the road, its future use is unknown.
- No significant slopes were observed in this stretch of the road.

F1. The roads have no drainage ditches, cleared areas in this stretch have no bluff.

F2. A lot of cracks and holes are observed in this area. Five kilometers before reaching Fátima, a trailer container can be seen on the road.

f) Delta 7 – Fátima – Boca Ceiba (mouth of the Río Sarapiquí (river))

- This stretch of the road is a distance from the recess of the Río San Juan.
- As indicated by CACISA, this stretch is the only part of the road that has been completed.
- The road has many cracks and holes in this stretch.
- It has no drainage slope or ditch, therefore, water accumulates in some parts and there is movement of *finos*.
- There are areas with boulders not apt for roads; in these areas the river is considerably oversized and passage of vehicles creates splashes to the sides.
- A Bailey-type bridge, in poor condition, is observed. Its structure is rusty; other bridges with wooden logs are also observed.
- Along this stretch it is difficult to determine the type of soil unearthed during excavation for *gavetas* and possible contamination of the base. The ground seems saturated and its drainage slope is insufficient for release of the *finos.*
- PVC pipe for drainage can be seen in a stretch of the road in Fátima. The pipe is an obstruction whose entrance and drainage point are unprotected.
- As observed, in some sections there are slopes approximately four meters high with very elevated margins.

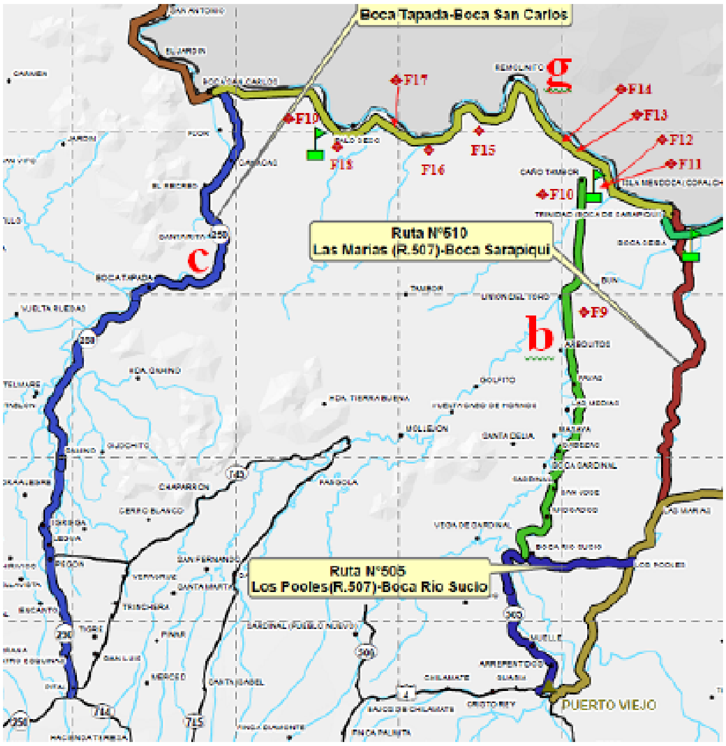

F3. A PVC drainage is obstructed by movement of *finos* of the base layer.

F4. The Bailey bridge is in a state of advanced deterioration, with loose planks.


F5. Bridge with a base built from wooden logs.


F6. The route has no drainage, there are cracks and holes, and areas where there are oversized boulders not apt for roads.

Diagram No. 3, Visit b, g and c:



b) District route: Mouth of the Río Sucio (river) – Tambor Spring

- This route already existed, but it was rehabilitated.
- The route is generally in good condition, but there are cracks and holes in some areas.
- There is no drainage in this stretch of the route.
- There are no slopes conformed by bluffs.
- Machinery and stored supplied are present in view of the re-initiation of the project.

F9. The route is generally in good condition.

F10. Machinery and stored supplies were observed.

g) Tambor – Remolinito Spring – Palo Seco – Boca San Carlos (Boca Sarapiquí to Boca San Carlos)

- Most of this route consists of dirt roads with some leveling beginning, some areas cannot be transited. There is no drainage and water accumulates in different places.
- There is an approximately 10 kilometer stretch that basically consists of paths between different plots of land. The impact of machinery to this area is not evident.
- There are stretches where the recess on the bank of the Río San Juan should be revised; in some areas the recess is of approximately 10 meters.
- There are slopes up to approximately six meters high with very elevated margins.
- There are several bridges on wooden pillars.
- There is also a bridge comprised of two trailers containers and wooden logs. The walls of the trailers containers are already bulging and in imminent danger of collapsing. At this same point it is evident that the flow of a brook was rerouted.
- There are material deposits along the road, boulders that are too large for a road; the source of these deposits is unknown.
- A PVC pipe drain under construction was observed.
- There is machinery for the construction of ditches and accumulated material for the re-initiation of the project.
- Work was observed which could lead to environmental damage to forests and wetlands.
- In some stretches there is no evidence of the due leveling nor of adequate stabilization, since impermeable material, not apt for roads, was observed.
- The same excavation material has been used as landfill and it is unknown if that material was subjected to laboratory tests to decide its use.


F11. Paths with compacted earth.

F12. Dirt roads where water has accumulated making transit impossible. Impact on the forest can be observed.

F13. Different bridges on wooden pillars can be observed.


F14. A dirt road with no drainage; as it was not based on plans, disorganized cuts and fills were carried out.

F15. An approximately 10 kilometer stretch which basically consists of paths between lots; transit along this road is very difficult even with 4x4 vehicle.

F16. Deforestation and impact on the zone's wetlands are evident.

F17. Evident in the first photo (a) is the obstruction of the natural flow of the river; the second photo (b) shows the construction of a canal for re-routing the flow of the river; the last two photos (c and d) show the construction of a bridge where wooden logs and two container trailers used for drainage are part of the structure; bulging can be seen; bulging in the walls of the container trailers can also be seen.

It is important to indicate that in this area far more work has been done across the road than in the areas previously mentioned; the reason for this is not clear.

F18. There are stretches of the road where its path is very close to the bank of the Río San Juan, these stretches of the road should be re-evaluated.

Piling of material

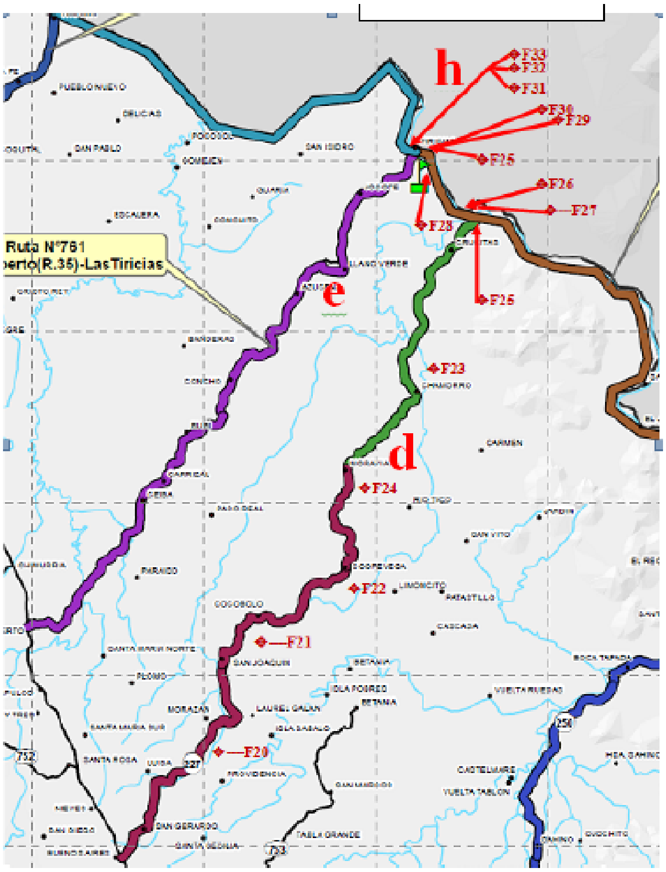
Trench

Río San Juan

F19. Materials used are only meters away from the Río San Juan; very big boulders can be observed as well as piles of broken boulders. Here, what is apparently a trench is located between the Río San Juan and the road, several meters from the river. These situations should be evaluated.

The edge of the road

Diagram No. 4, Visit d, e and h



d) Buenos Aires – Moravia – Crucitas

- This route already exists, however, it was rehabilitated.
- The route is generally in good condition but there are cracks and holes in some areas.
- Ditches are in need of maintenance and some stretches have no drainage.
- There are slopes of up to six meters high with very high margins.
- Wetlands have been impacted upon.

- There is an abandoned trailer container on the road whose use is unknown.
- This route was impossible to use for access to the border road. A locked gate blocks off the road and it was impossible to continue.
- With the help of neighbors the road was reached by crossing from Crucitas to Jocotes by way of unkempt paths and on to the Tiricias areas.

F20. Lack of maintenance to the drainage canals.

F21. One of the areas with cracks and holes, besides very elevated longitudinal slopes.

F22. Slope approximately six meters in height with an almost vertical slope.

F23. Possible impact to wetlands.


F24. Areas with cracks and holes and no drainage.

F25. In the Crucitas areas, a gate obstructs the path to the border road.

F26. There is a trailer container on the road approximately one kilometer before reaching Tiricias.

h) The 15 kilometers in the area near Tiricias.

- Approximately seven kilometers toward Tiricias – Crucitas were covered, and 7.5 kilometers toward Tiricias – Trocha; since these stretches of the road are in gravel and in view of the conditions of the path, it was impossible to transit any further.
- Several areas have no drainage canals or ditches.
- In several stretches of the road that were inspected the path of the road is a short distance from the bank of the Río San Juan, some of these bluffs are at a distance of approximately 15 meters.
- There are huge slopes with high peaks and no protection whatsoever.
- There is river water flowing along paths formed by logs of wood.
- There are also bridges built with logs of wood.

- Diverse materials have been deposited along the edge of the path of the road including very large boulders and machinery can also be observed; however, no persons are observed operating this machinery.
- There is possible alteration to the wetlands, deforestation and still water with no drainage.


F27. There are huge slopes with high peaks in this area and no protection whatsoever.

F.28. There are huge slopes with high peaks in this area and no protection whatsoever.


F29. In this area the recess from the Río San Juan is approximately 15 meters.

F30. In this area there is also a trench from which materials were extracted.


F31. Deforestation in wetlands area.


F32. Wooden logs are used to allow for the drainage of water.

F33. Recess from the river in this area should also be evaluated for compliance with the law.

F35. Materials and machinery depot.

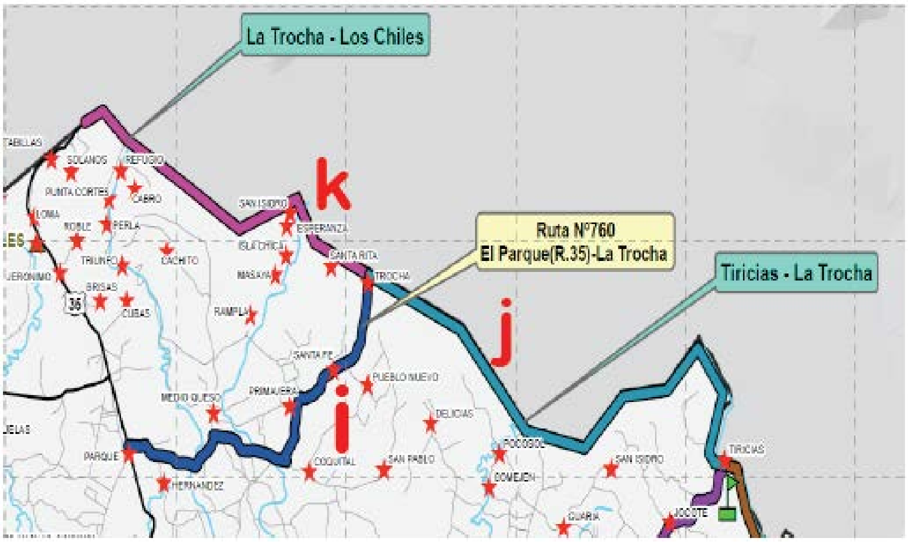
F34. Stagnant water with no drainage whatsoever.

F36. Work in this area is incomplete.

F37. Gravel ends in this area. The dirt road is almost impossible to transit. Impact on the forest is noticeable.

Diagram No. 5

Visits I, j and k



i) Route 760 Parque – La Trocha

- Dirt road which already exists, and on which there seems to have been no work to improve transit.
- Conditions are generally acceptable and in some areas the paths are on plots of land.
- The drainage canals are in need of maintenance, and in some stretches there are none.

F38. Dirt road from Route 760 El Parque.

j) Approximately five kilometers of Trocha toward Los Chiles

- 4.6 Kilometers towards Trocha – Los Chiles were transited.
- Along this stretch there is a road comprised of dirt, of varying width; the earth is uneven in some parts and at one point it is only wide enough for one vehicle; there is cultivated land on one side.
- There is no drainage or ditches.
- In some places river water runs though round plastic pipes.
- There are bridges built out of wooden logs and trailer containers.
- There is stagnant water with no canals; there is deforestation alongside some stretches.


F39. Front-view of a stretch of the road where the earth is uneven.

F40. A stretch of the road wide enough for only one vehicle.


F41. Circular pipe serving as outlet for river water.

P42. A stretch of the road wide enough for only one vehicle.

F43. Stagnant water and deforestation.

k) Approximately 23 kilometers of road toward Tiricias.

- Approximately 23.1 kilometers were transited in direction to Trocha – Tiricias.
- Some stretches are a dirt road, others are paved gravel. The part where the route is marked was reached but its condition is not conducive to vehicular transit.
- Clearing of areas approximately three to six meters high.
- There are no drainage canals or ditches.
- Circular pipes serving as outlets for river water.
- There are bridges built of wooden logs and trailer containers. Some of the trailer containers have deteriorating sides.
- There are also bridges and water outlets constructed of wooden logs.
- There is stagnant water with no drainage canals.
- There are few areas with ditches to channel water.

Diagram No. 6. Construction details regarding areas of this stretch that was visited.

F44. View of a dirt stretch.

F45. View of a gravel stretch.

F46. Circular pipes serving as outlets for river water.

F47. Trailer container used as a bridge.


F48. Bridge and waterway with wooden logs.

F49. Bridge being used for heavy machinery.


F50. Clearing of slope approximately six meters high.

F51. End of the part of the road that can be transited.


F52. Dirt drainage ditch serving as water outlet.

F53. Stagnant water present in some parts.

5. CONCLUSIONS

5.1 The project was visited on 24 – 25 May and 7 June 2012 for the purpose of verifying the work done and the present state of Route 1856. The visit was carried out by inspectors of the Department for Inspection and Standards, and the Northern Regional Office.

5.2 Maps of the stretch of the border road and the different access routes were made available. The length of Route 1856 is approximately 160 kilometers and the different arteries that access it are a sum of 400 kilometers. Due to the absence of bridges interconnecting the route in some stretches (the mouths of the Sarapiquí, San Carlos and Pocosol rivers among others) for the time being it is impossible to uninterruptedly transit the road, besides the fact that in some stretches of the different parts of the road work has yet to begin. The project has no plans or preliminary studies, a situation that was corroborated through use of the CFIA database where there is no record of the project.

5.3 The route was constructed without a single plan to indicate the path that was to be opened, or what its characteristics should have been. This situation causes increased costs, environmental problems, and a rapid deterioration of the project.

5.4 The lack of adequate drainage for channeling rainwater was observed. It can be foreseen that this situation can prematurely erode the work already done. It should be mentioned that in some areas trailer containers were used for greater drainage in the channeling of brooks. These trailer containers already reflect deterioration and are at risk of collapsing as reflected in the photographs included in this report.

5.5 It is unknown if soil samples were analyzed, and without such analysis the top base could suffer premature contamination due to the material used.

5.6 As reflected in the photographs and as observed along certain stretches, it is presumed that protected areas were not taken into account. As defined by Forests Law No. 7575, Article 33, Section ii, a protected area is "a 15 meters strip in a rural zone and 10 meters in an urban zone, horizontally measured on both sides of the bank of a river, a brook or stream if the land is flat, and fifty horizontal meters if the land is uneven." Further, according to the Law No. 276 to Regulate Water Resources, Article 31, Section ii, "The forest area that protects or should protect the land that filters drinking water as well as those that assist in the formation of hydrographic basins and accumulation areas, supply sources, or permanent pathways for the same water," are declared reserves that are subject to dominion of the Nation.

5.7 Once the Río San Juan was declared a navigable river in Decree No. 4 of 23 February 1966, "… Río San Juan. According to the Cañas Jérez Treaty of 1858 and the Cleveland Decision of 1888, Costa Rica has access to the free navigation of commercial ships in the San Juan de Salinas bays, as well as in the Río San Juan from its mouth to three nautical miles (5.6 kilometers) before the Castillo Viejo or San Carlos. The distance between the latter point and the beginning of the Río Colorado is 100 kilometers," and according to Article 7 of the Lands and Colonization Law: "b) the land encompassed in the 50 meters wide zone along both banks of navigable rivers…" "are declared Agricultural Property of the State." This should be evaluated by technical experts since there are doubts regarding the recesses of the road along the Río San Juan in some stretches where it is only a few meters from the bank.

5.8 Technical criteria for land removal are unknown since the excavation and landfill are unstable, and transit is almost impossible in some areas due to very elevated longitudinal slopes. Where there is leveling, compacting of the earth is very poor.

5.9 An evaluation for possible environmental damage should be done since there are wetlands in the area that may have been impacted by deforestation and use of material from the Río San Juan bank; besides the fact that brooks have been rerouted, and the boulders that have been used in some areas are from the river, many of them oversized. It is unknown if material was extracted from a nearby river and if the necessary permits for this were applied for.

5.10 Regarding impact on wetlands it should be noted that in conformity with Article 45 of the Organic Environmental Law, "Activity which interrupts the normal cycles of wetlands ecosystems, as well as the construction of dykes which interrupt the flow of sea or continental water, drainage, desiccation, landfill or any other alteration that provokes deterioration or elimination of such ecosystems, is prohibited." Therefore, this situation should be evaluated by technical experts in this field.

6. RECOMMENDATIONS

6.1 That, to ensure the necessary follow through process, this department forward a copy of this report to Engineer Olman Vargas Zeledón so it can be brought to the General Directorate which requested it.

6.2 Short-term interventions

- Immediate construction of drainage canals in all stretches of the road where gravel is already in place; and their construction in the winter in areas where this is still a dirt road.
- Maintenance of drainage canals in the stretches where they already exist, especially in the arteries that access the road.
- Stabilization of the slopes with high margins and significant dimensions in order to avoid landslides during the rains that are about to begin.
- The immediate design and construction of the necessary bridges in the Pocosol River, the mouths of the Río Sarapiquí, the Río San Juan, and of the Río Infiernito, which would make possible continuous transit along the whole of the road.
- The substitution of wooden logs, trailer containers and drainages that are being used as bridges and water pathways under the road, as these do not comply with minimal structural design and engineering mechanics requirements.

6.3 Midrange second phase work

- Evaluation of the recesses of Río San Juan by way of a technical study under present applicable law.
- A detailed topographical blueprint of all work done to the present.
- Development of all pertinent designs and construction blueprints for the whole of the project.
- Compacting of all landfill, and the laboratory tests of all materials used for the base of the road and leveling.

- Substitution of wooden logs, trailer containers and drainage canals used as bridges or water pathways under the road which do not comply with the minimal structural design and engineering mechanics requirements.

Inspectors,

Engineer Austin Shen Ti	Engineer Francisco Reyes Cordero
Engineer Luis Diego Alfaro Artavia	Engineer Luis Castro Boschini
Engineer Alexander Guerra Morán	

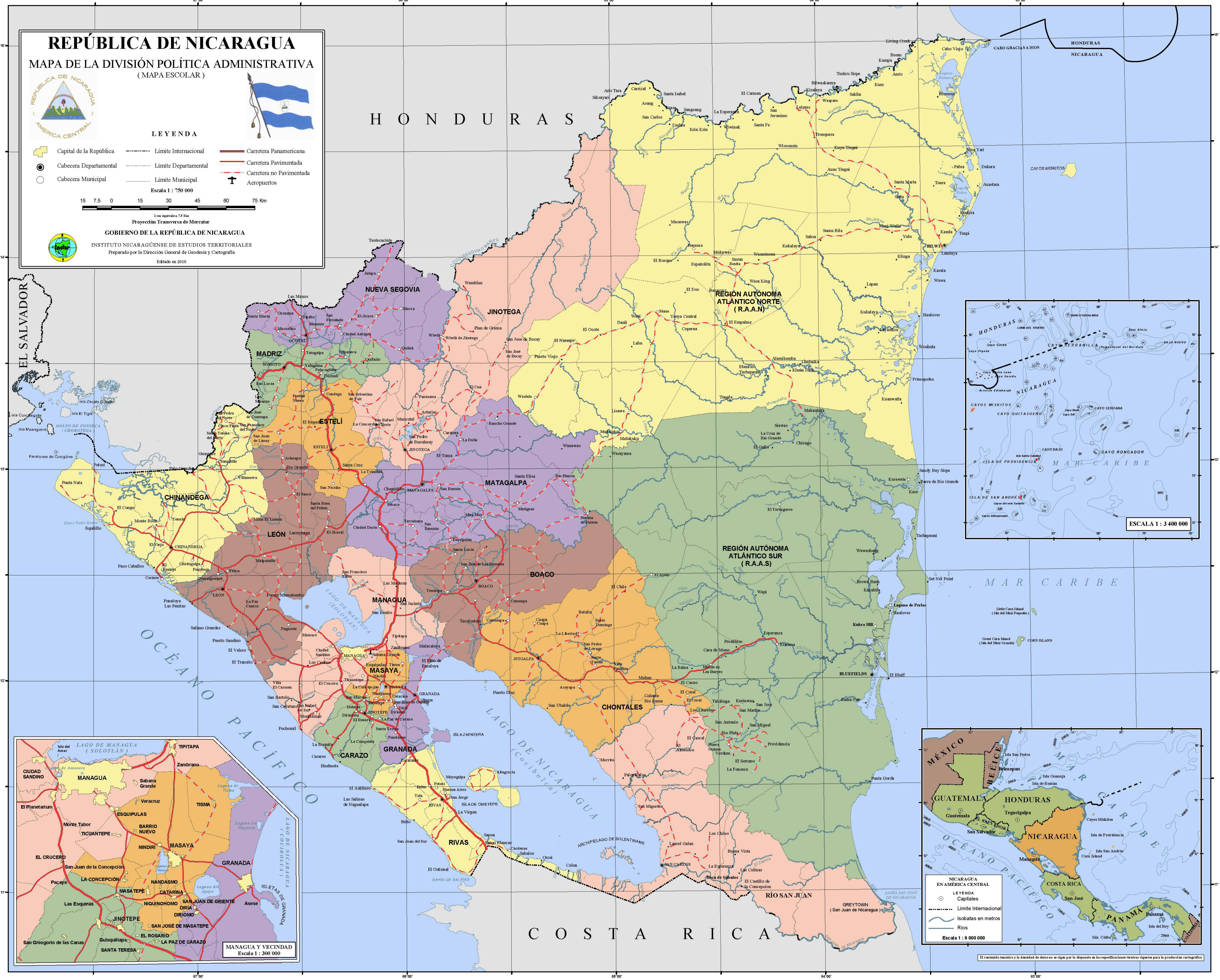
And Architects

Marielos Alfaro Herra Chief of Regional Office	V.B. Carlos R. Murillo Gómez Chief of CFIA Procedures Dept.

Annex 118

Map of the Republic of Nicaragua (INETER)
available at http://www.ineter.gob.ni/

BAHÍA SAN JU
DE NICARAG
GREYTOWN
(San Juan de Nicaragua)

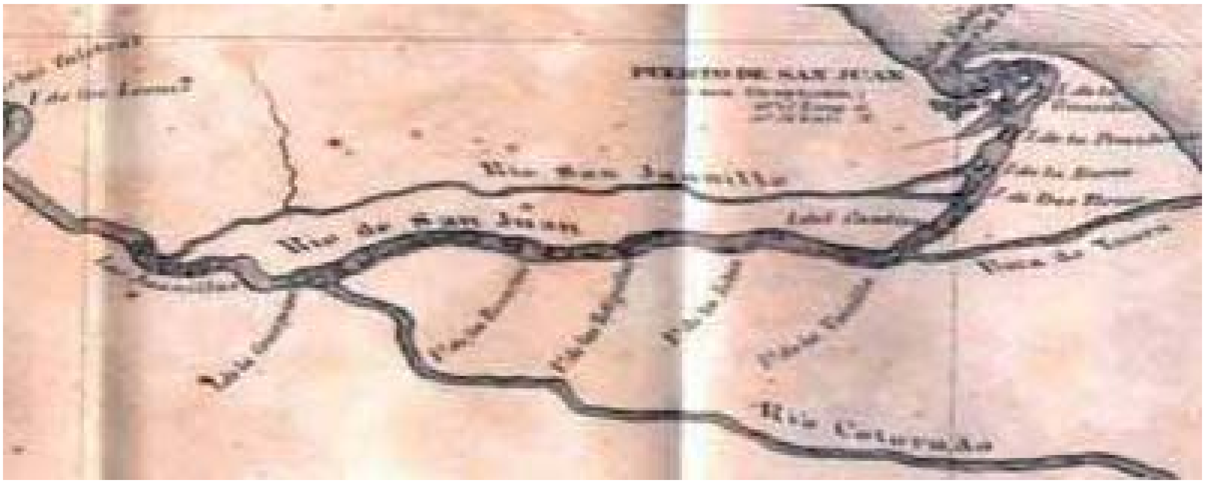


REPÚBLICA DE NICARAGUA
MAPA DE LA DIVISIÓN POLÍTICA ADMINISTRATIVA
(MAPA ESCOLAR)
LEYENDA
Capital de la República
Cabecera Departamental
Cabecera Municipal
Límite Internacional
Límite Departamental
Límite Municipal
Carretera Panamericana
Carretera Pavimentada
Carretera no Pavimentada
Aeropuertos
Escala 1 : 750 000
Proyección Transversa de Mercator
GOBIERNO DE LA REPÚBLICA DE NICARAGUA
INSTITUTO NICARAGÜENSE DE ESTUDIOS TERRITORIALES
H O N D U R A S
EL SALVADOR
NUEVA SEGOVIA
MADRIZ
JINOTEGA
ESTELÍ
CHINANDEGA
LEÓN
MATAGALPA
REGIÓN AUTÓNOMA ATLÁNTICO NORTE (R.A.A.N)
REGIÓN AUTÓNOMA ATLÁNTICO SUR (R.A.A.S)
BOACO
MANAGUA
MASAYA
CARAZO
GRANADA
CHONTALES
RIVAS
RÍO SAN JUAN
O C É A N O P A C Í F I C O
M A R C A R I B E
C O S T A R I C A
MANAGUA Y VECINDAD
Escala 1 : 300 000
ESCALA 1 : 3 400 000
MÉXICO
BELICE
GUATEMALA
HONDURAS
NICARAGUA
COSTA RICA
PANAMÁ

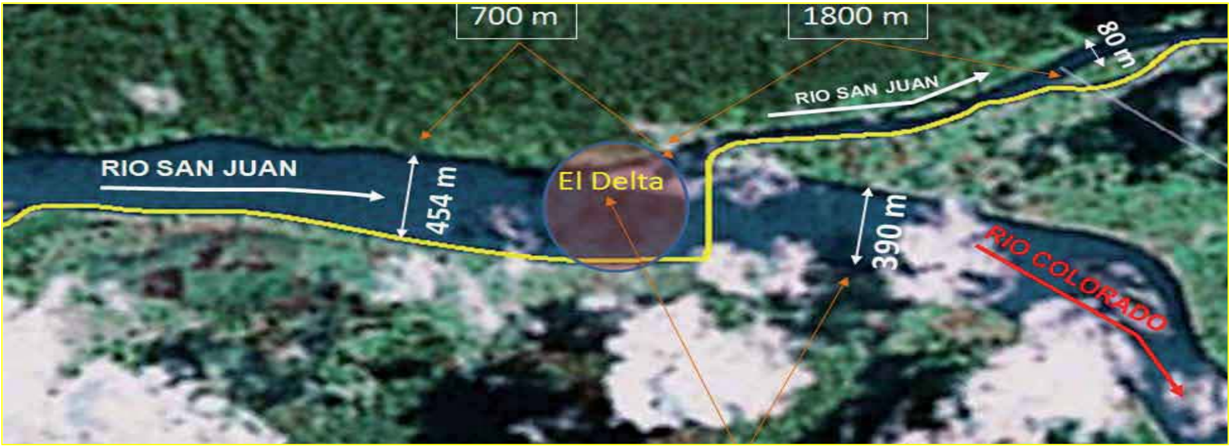
Annex 119

Baron A Bulow 1851 (A)
2010 Satellite Image (B)
Land Info Image of River (C)
Map of the Republic of Nicaragua by Maximilian Sonnestern 1858 (D)

Baron A Bulow 1851 (A)

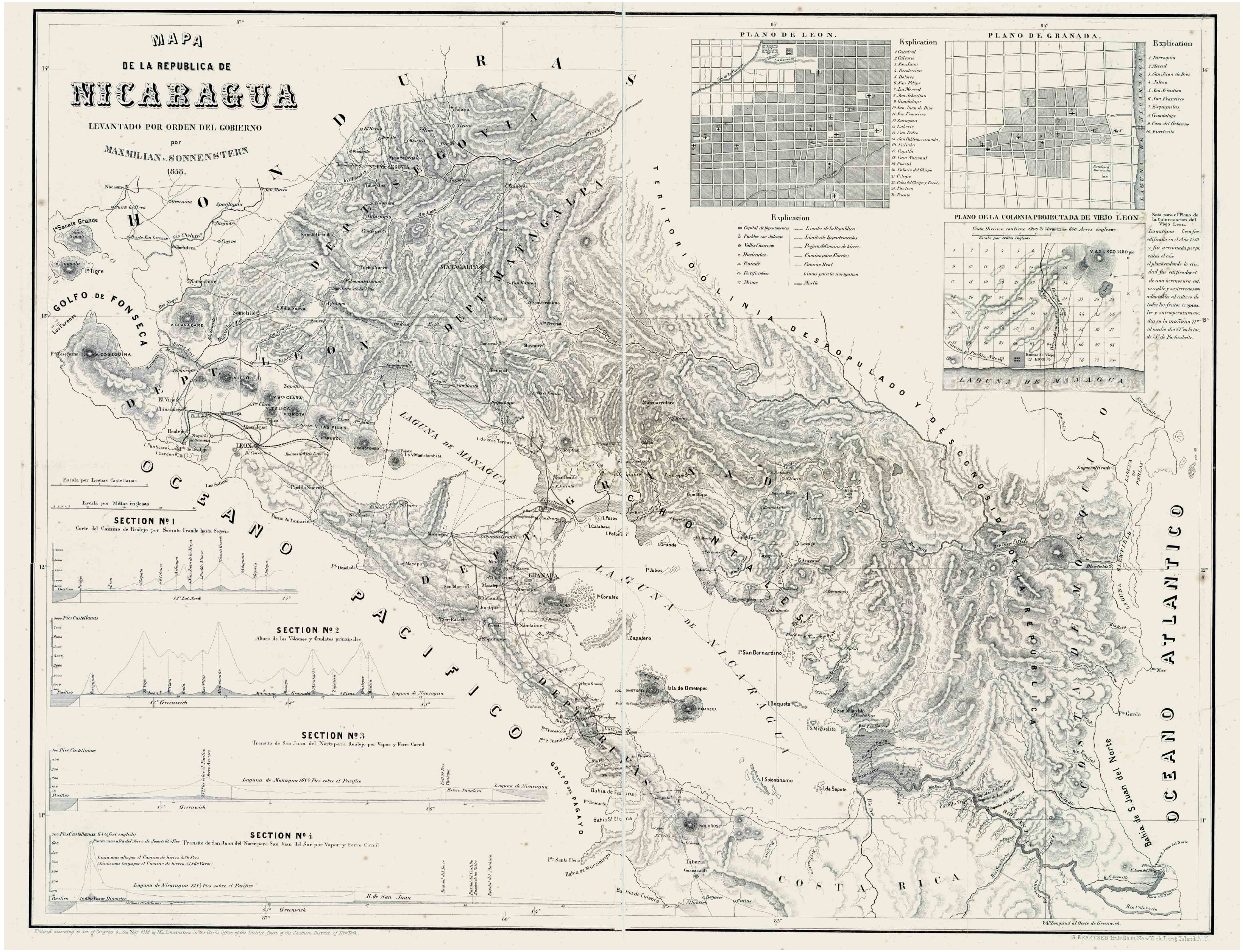


2010 Satellite Image (B)



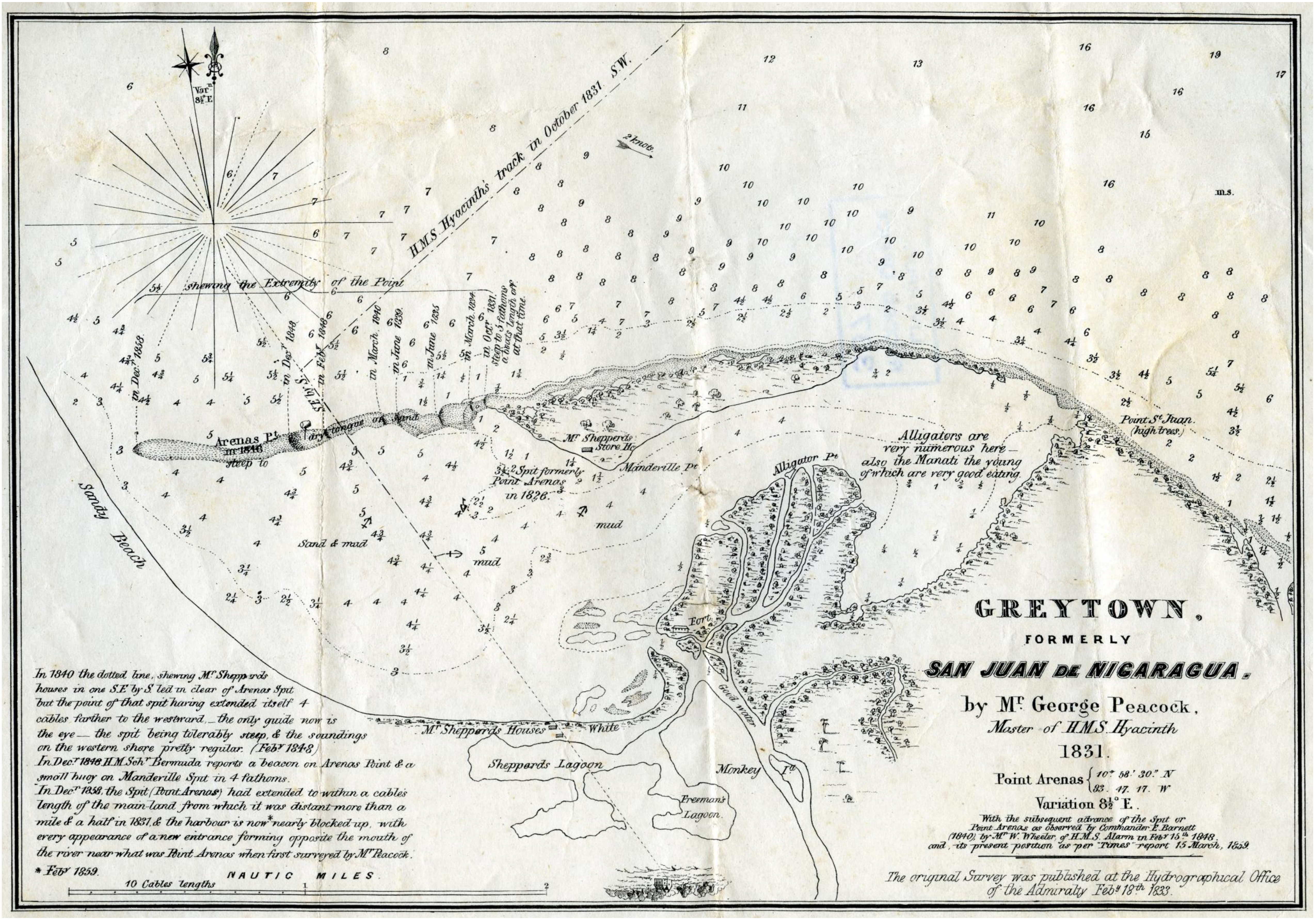
Land Info Image of River (C)

Map of the Republic of Nicaragua by Maximilian Sonnestern 1858 (D)



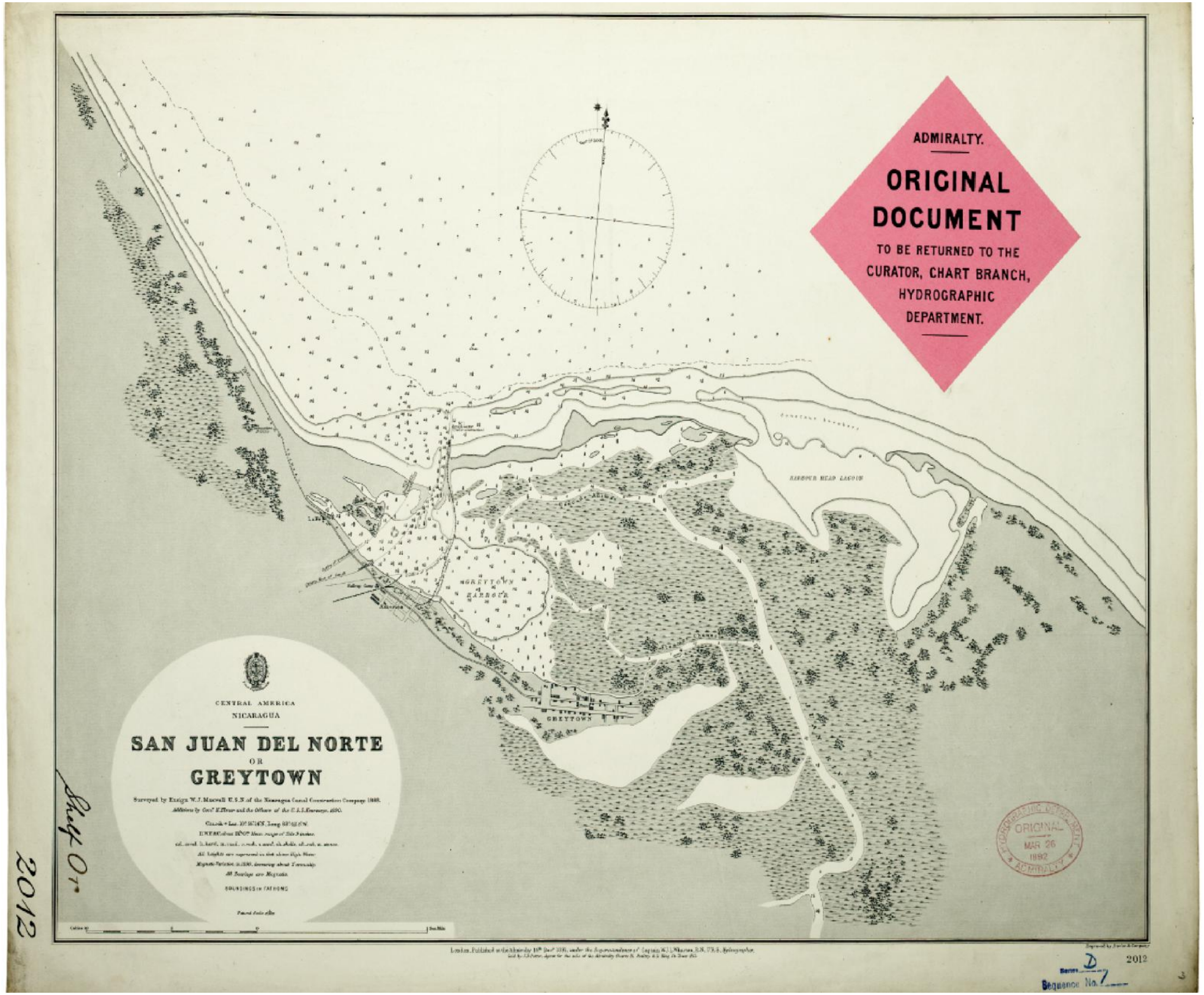
Annex 120

Map of 1831 by Mr. George Peacock with additions up to 1859


GREYTOWN,
FORMERLY
SAN JUAN DE NICARAGUA.
by Mr. George Peacock,
Master of H.M.S. Hyacinth
1831.
Point Arenas { 10°. 58.' 30." N / 83. 47. 17. W
Variation 8½° E.
With the subsequent advance of the Spit or Point Arenas as observed by Commander E. Barnett (1840), by Mr. W. Wheeler, of H.M.S. Alarm in Feby. 15th. 1848, and, its present position as per "Times" report 15 March, 1859.
The original Survey was published at the Hydrographical Office of the Admiralty Feby. 18th. 1833.
In 1840 the dotted line, shewing Mr. Sheppards houses in one S.E by S. led in clear of Arenas Spit but the point of that spit having extended itself 4 cables farther to the westward, _ the only guide now is the eye — the spit being tolerably steep, & the soundings on the western shore pretty regular. (Feby. 1848)
In Decr. 1848 H.M. Schr. Bermuda reports a beacon on Arenas Point & a small buoy on Manderille Spit in 4 fathoms.
In Decr. 1858, the Spit (Point Arenas) had extended to within a cables length of the main-land from which it was distant more than a mile & a half in 1831, & the harbour is now* nearly blocked up, with every appearance of a new entrance forming opposite the mouth of the river near what was Point Arenas when first surveyed by Mr. Peacock.
* Feby. 1859.
NAUTIC MILES
10 Cables lengths
H.M.S. Hyacinth's track in October 1831. S.W.
shewing the Extremity of the Point
Arenas Pt. in 1848
Dry tongue of sand
steep to
Sandy Beach
Sand & mud
mud
Spit formerly Point Arenas in 1826.
Mr. Sheppards Store Ho.
Manderille Pt.
Alligator Pt.
Alligators are very numerous here _ also the Manati the young of which are very good eating.
Point St. Juan. (high trees)
Fort
Mr. Sheppards Houses
White
Sheppards Lagoon
Monkey Id.
Freemans Lagoon
Good water
2 knots
Var. 8½° E.

Annex 121

Central America, Nicaragua San Juan del Norte or Greytown
Maxwell chart of 1888


ADMIRALTY.
ORIGINAL DOCUMENT
TO BE RETURNED TO THE CURATOR, CHART BRANCH, HYDROGRAPHIC DEPARTMENT.
GREYTOWN
HARBOUR HEAD LAGOON
CENTRAL AMERICA
NICARAGUA
SAN JUAN DEL NORTE
OR
GREYTOWN
SOUNDINGS IN FATHOMS
2012
ORIGINAL
MAR 26
1892
2012

Annex 122

Republic of Nicaragua, by L. Robelin (191-) (A)

Republic of Nicaragua, by A. Demersseman (1923) (B)

Nicaragua Ministry of Development, General Department of Cartography (196-) (C)

Nicaragua, by Richard Mayer 1920 (D)

Map of the Republic of Nicaragua and part of Honduras and Costa Rica, by Clifford D. Ham (1924) (E)

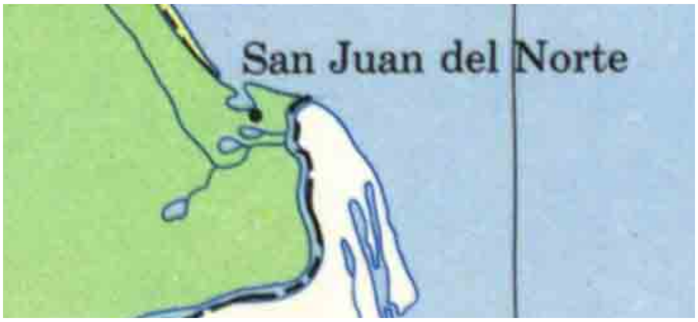
Nicaragua Ministry of Development , General Department of Cartography (1965) (F)

Nicaragua Ministry of Development , General Department of Cartography (1966) (G)

Republic of Nicaragua, by L. Robelin (191-) (A)

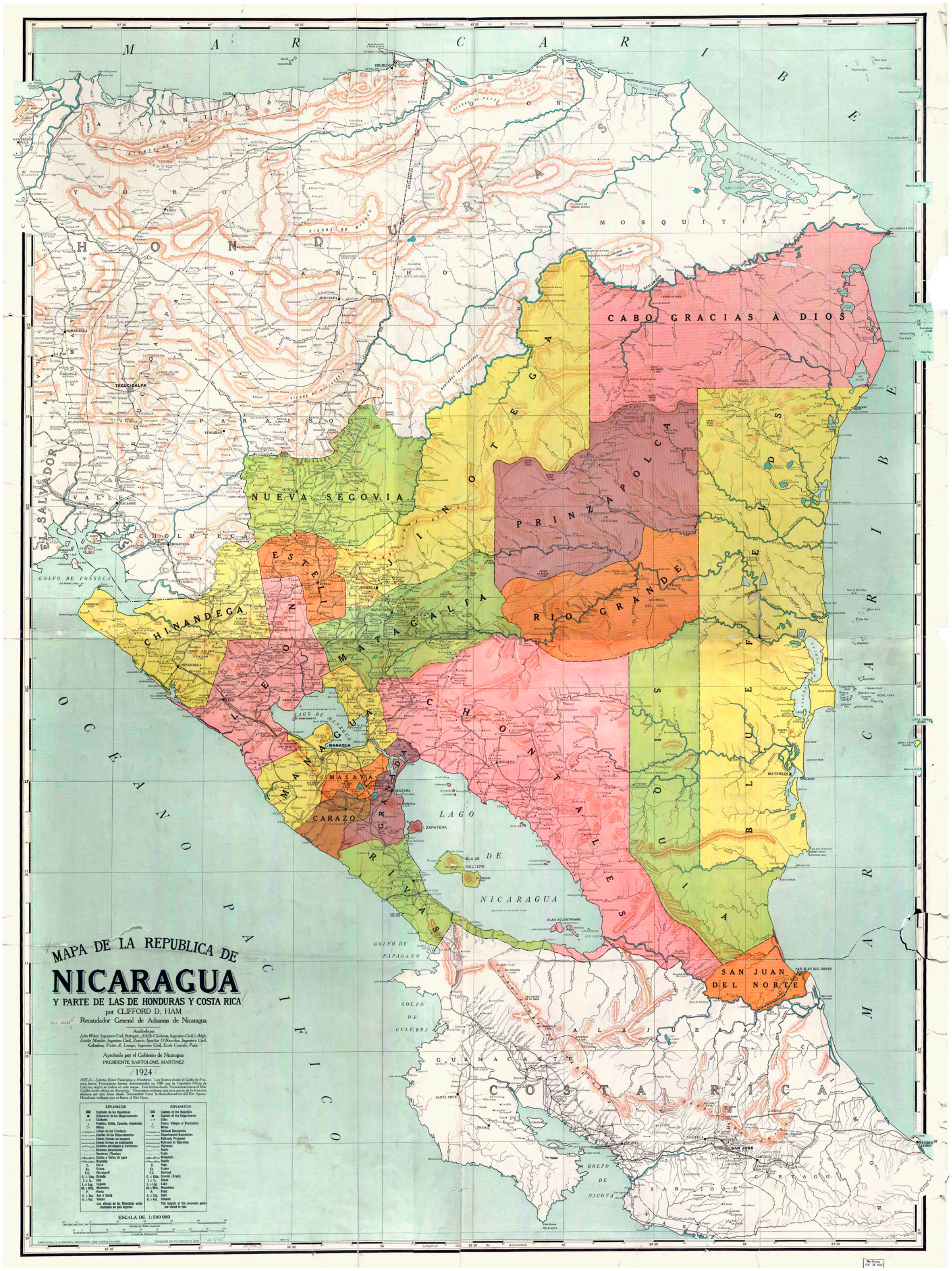
Republic of Nicaragua, by A. Demersseman (1923) (B)

Nicaragua Ministry of Development, General Department of Cartography (196-) (C)

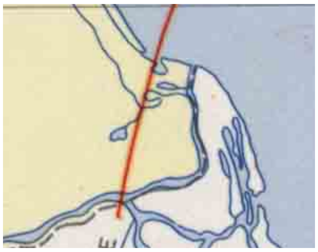


Nicaragua, by Richard Mayer 1920 (D)

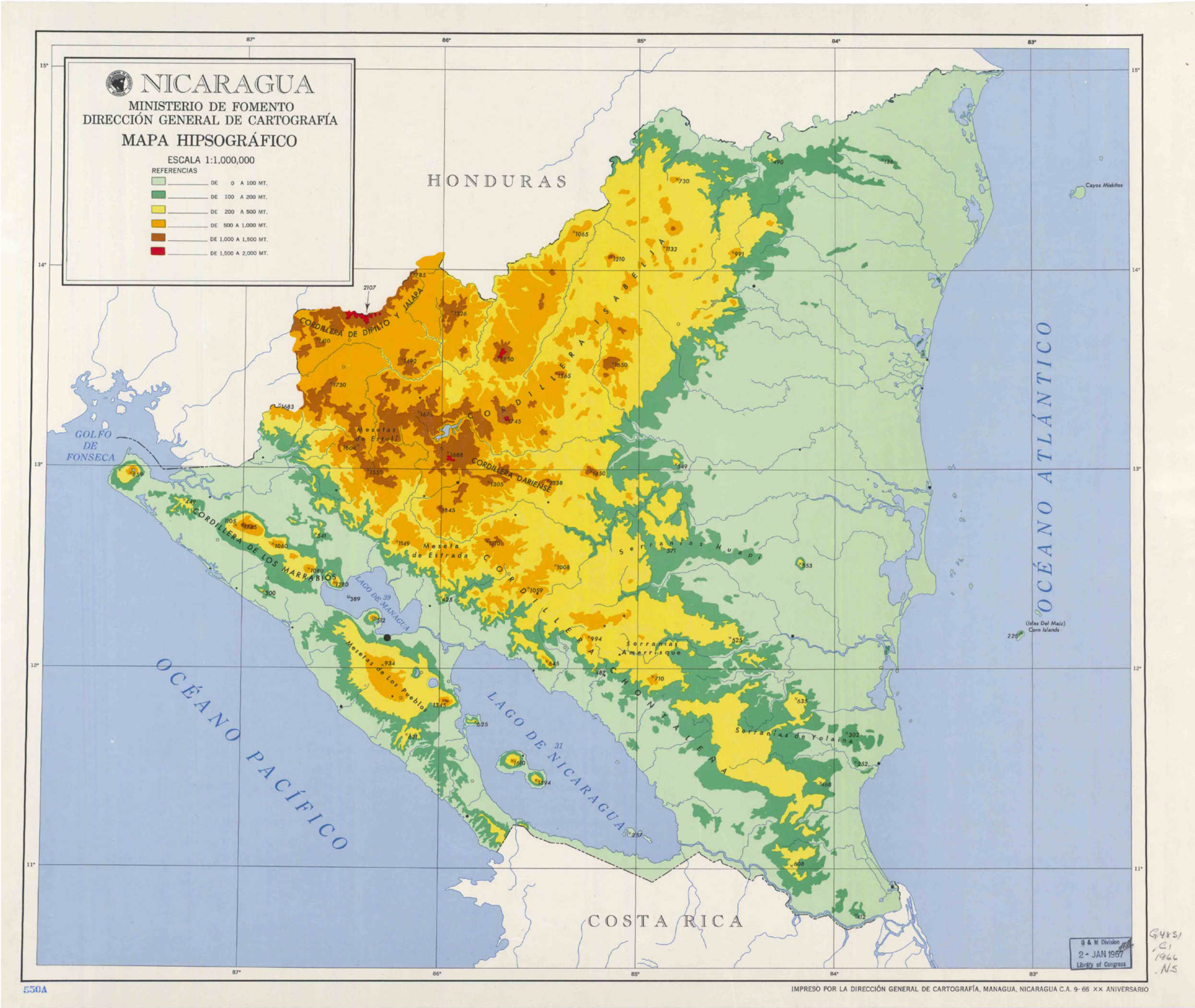
Map of the Republic of Nicaragua and part of Honduras and Costa Rica, by Clifford D. Ham (1924) (E)



Nicaragua Ministry of Development, General Department of Cartography (1965) (F)

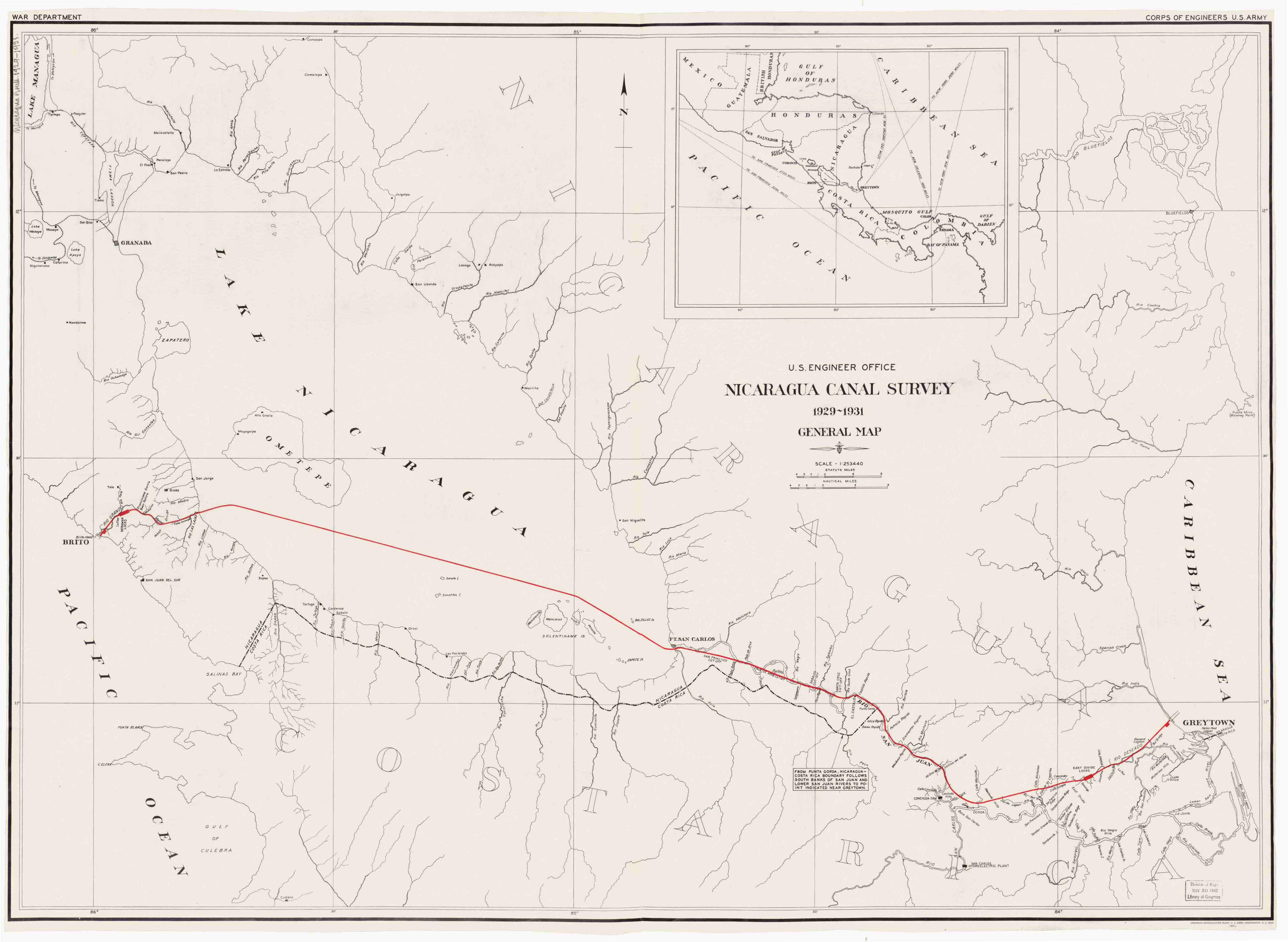


Nicaragua Ministry of Development, General Department of Cartography (1966) (G)



Annex 123

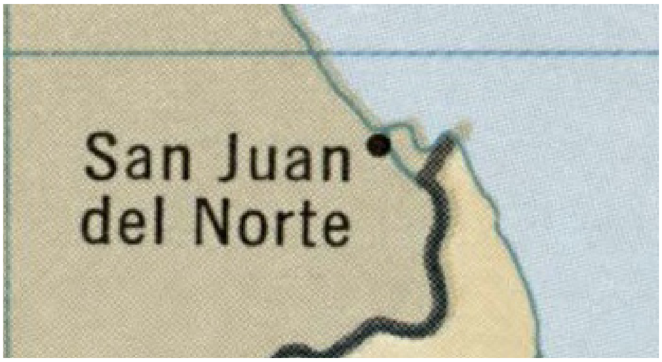
US Engineer Office Nicaragua Canal Survey (1929-31)


WAR DEPARTMENT
CORPS OF ENGINEERS U.S. ARMY
U.S. ENGINEER OFFICE
NICARAGUA CANAL SURVEY
1929~1931
GENERAL MAP
SCALE - 1:253440
STATUTE MILES
NAUTICAL MILES
FROM PUNTA GORDA, NICARAGUA–COSTA RICA BOUNDARY FOLLOWS SOUTH BANKS OF SAN JUAN AND LOWER SAN JUAN RIVERS TO POINT INDICATED NEAR GREYTOWN.
LAKE MANAGUA
GRANADA
LAKE NICARAGUA
OMETEPE
ZAPATERO
BRITO
SAN JUAN DEL SUR
SALINAS BAY
SOLENTINAME IS.
FT. SAN CARLOS
GREYTOWN
NICARAGUA
COSTA RICA
PACIFIC OCEAN
CARIBBEAN SEA
GULF OF CULEBRA
MEXICO
GUATEMALA
BRITISH HONDURAS
GULF OF HONDURAS
HONDURAS
SAN SALVADOR
PACIFIC OCEAN
CARIBBEAN SEA
MOSQUITO GULF
GULF OF DARIEN
BAY OF PANAMA

Annex 124

Costa Rica, U.S. Central Intelligence Agency, 1970, G4860 1970 U 51


COSTA RICA
International boundary
Provincia boundary
National capital
Provincia capital
Railroad
Road
0 20 40 Miles
0 20 40 Kilometers
ISLA DE COCO
0 1 2 Miles
NICARAGUA
PANAMA
CARIBBEAN SEA
PACIFIC OCEAN
LAGO DE NICARAGUA
GUANACASTE
ALAJUELA
HEREDIA
PUNTARENAS
SAN JOSÉ
CARTAGO
LIMÓN
San Carlos
San Juan del Norte
La Cruz
Liberia
Las Cañas
Arenal
Villa Quesada
Pital
Puerto Viejo
Santa Cruz
Nicoya
Puerto Jesús
Grecia
Barranca
Puntarenas
Alajuela
Heredia
SAN JOSÉ
Santiago
San Ignacio
Cartago
Turrialba
Guácimo
Siquirres
Matina
Limón
Liverpool
Atalanta
San Marcos
Suretka
Sixaola
Puerto Quepos
San Isidro
Dominical
Palmar Sur
San Vito
Golfito
Corredor
La Concepción
Puerto Jiménez
Puerto Armuelles
GOLFO DE NICOYA
Golfo Dulce
Inter-American Highway
Base 77668 10-70


San Juan
del Norte

Annex 125

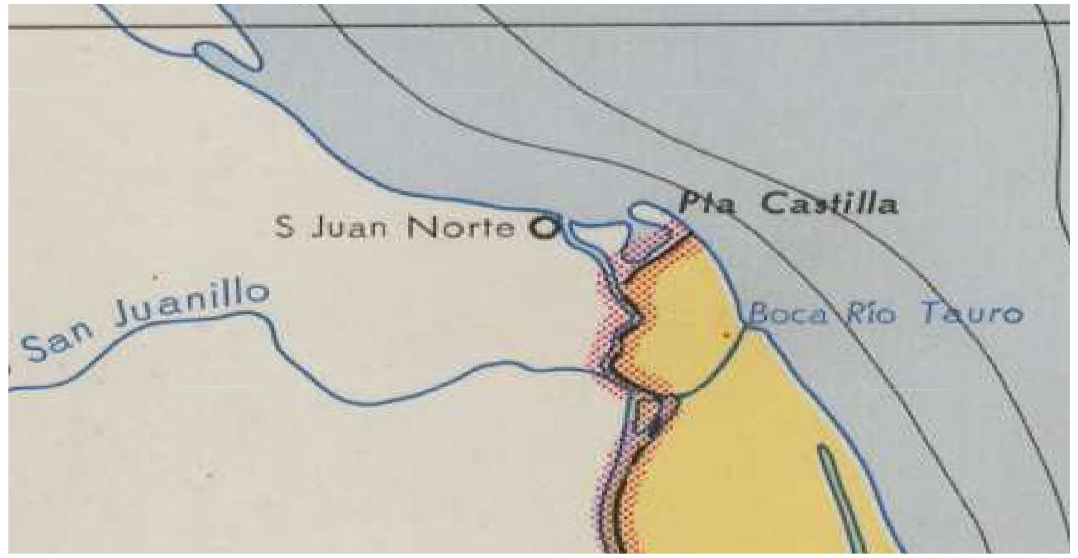
Costa Rica, U.S. Central Intelligence Agency, 1970 (2), G 4860 1970 U52


LAND UTILIZATION
Cultivated area, some upland pasture and grassland
Dense broadleaf evergreen forest
Open deciduous forest, savanna, and crops
Scrub, with some grassland
Swamp-chiefly palm and mangrove
POPULATION
Persons per square mile
0 26 65 130 518
0 10 25 50 200
Persons per square kilometer
Data from 1963 census, plotted by Canton
ECONOMIC ACTIVITY
INDUSTRY
Food processing
Beverages
Textiles and clothing
Lumber and wood products
Coffee processing
Tobacco processing
Chemicals
Oil refinery
AGRICULTURE
Coffee
Bananas
NICARAGUA
LAGO DE NICARAGUA
San Juan del Norte
CARIBBEAN SEA
PACIFIC OCEAN
PANAMA
ALAJUELA
GUANACASTE
HEREDIA
CARTAGO
LIMON
SAN JOSE
PUNTARENAS
COSTA RICA
International boundary
Provincia boundary
National capital
Provincia capital
Railroad
Surfaced road
Unsurfaced road
Airfield
Principal port
Secondary port
Populated places
5,000 to 25,000
Under 5,000
Spot elevations in feet
Scale 1:1,500,000
Statute Miles
Kilometers
ISLA DE COCO


San Juan
del Norte

Annex 126

Official Map of Costa Rica, Geographic Institute of Costa Rica, 1971


S Juan Norte
Pta Castilla
San Juanillo
Boca Río Tauro


MAPA FISICO-POLITICO 1:500.000
COSTA RICA
EDICION PROVISIONAL 1971
LAGO DE NICARAGUA
NICARAGUA
GOLFO DE PAPAGAYO
LLANURA DE LOS GUATUSOS
ALAJUELA
LLANURA DE SAN CARLOS
LLANURA DE TORTUGUERO
GUANACASTE
HEREDIA
LIMON
LLANURA DE SANTA CLARA
GOLFO DE NICOYA
PUNTARENAS
SAN JOSE
CARTAGO
MAR CARIBE
ESCALA 1:100.000
ISLA DEL COCO
OCEANO PACIFICO
OCEANO PACIFICO
VALLE DE LA ESTRELLA
VALLE DE TALAMANCA
PANAMA
BAHIA DE CORONADO
VALLE DEL DIQUIS
GOLFO DULCE
ZONA CENTRAL
ESCALA 1:250.000
ALAJUELA
HEREDIA
SAN JOSE
CARTAGO
LIMITES DE ALTITUD
BAHIA DE CHARCO AZUL O DE DAVID

Annex 127

Texaco (1978)

San Juan del Norte
Silico

TEXACO NICARAGUA
LEON
GRANADA
MANAGUA
San Juan del Sur
NICARAGUA
Nicaragua tiene la extensión territorial más grande de Centroamérica. Tiene 410 Kms. de costa en el Pacífico y 551 Kms. en el Atlántico. La mayoría de sus habitantes viven en el sector de la Costa del Pacífico. Goza de un clima tropical con dos estaciones al año: una seca que comienza en Noviembre y termina en Abril y otra lluviosa que empieza en Mayo y finaliza en Octubre.
Managua, la capital, situada a la orilla Sur del Lago de su mismo nombre es una ciudad en proceso de construcción en la periferia de la ciudad destruída por el terremoto de Diciembre 1972. En construcciones es actualmente una de las mas dinámicas de Centro América pues contínuamente nuevas estructuras antisísmicas se levantan con todos los adelantos en comodidad y funcionalidad, en los que se están invertiendo centenares de millones de Córdobas, que es la unidad monetaria nacional, equivalente a 7 x 1 Dólar.
León, hacia el Noroeste de la capital, es la segunda ciudad en importancia y fué capital en la época de la colonia. Tiene una antigua y hermosa Catedral colonial, donde reposan los restos de Ruben Darío, uno de los grandes poetas en el idioma Español. Tiene también una excelente Universidad a la que asisten estudiantes de todos los países Centroamericanos. Cerca de León, unido por excelente carretera, está el Balneario Poneloya que es muy visitado todos los veranos por miles de turistas.
Sigue en importancia Granada, ciudad de gran belleza a orillas del Lago de Nicaragua. Es rica en historias de piratas y acciones revolucionarias, y fue también refugio de misioneros. En el gran lago surgen una variedad de isletas de diversos tamaños y belleza natural muy dignas de conocer. Son 318 isletas en total. Ha sido motivo de estudio la existencia de tiburones y otras fieras marinas en este lago de agua dulce. Por medio del Rio San Juan desemboca el Lago en el Océano Atlántico, y esta ruta fluvial ha sido considerada para la posible construcción de un canal interoceánico, y fué favorita de piratas y ricos navieros comerciantes del siglo pasado. Este río cuenta con muchas historias y leyendas.
Los Departamentos del Norte: Matagalpa, Jinotega, Estelí, Nueva Segovia y Madriz gozan de clima fresco, entre 15 y 20 grados. Es importante zona productora de café.
Las zonas ganaderas más importantes están en los Departamentos de Rivas, Boaco, Chontales y Rio San Juan.
La riqueza minera en oro, plata, y madereras está localizada en el Departamento de Zelaya que cuenta con dos magnificos Puertos: El Bluff y Cabezas.
La zona agrícola mas importante del país está localizada en el Departamento de Chinandega. La mayor parte de la producción algodonera del país se concentra aquí, y naturalmente hay grandes inversiones en desmotadoras y maquinaria agrícola, fábricas de abonos y de insecticidas. En esta zona se encuentra la Central Azucarera más grande de Centroamérica. El Puerto de Corinto, uno de los mejores de Centroamérica, bien abrigado y con grandes facilidades de carga y descargue para el comercio de importación y exportación de Nicaragua, está situado en este Departamento, que cuenta también con la mejor y mas corta carretera para conectar con Honduras y demás países del Norte.
San Juan del Sur
INDICE
78-696517

Annex 128

Nicaragua, U.S. Central Intelligence Agency (1979)


Nicaragua
International boundary
Department boundary
National capital
Department capital
Narrow gauge railroad
Surfaced road
Unsurfaced road
Airfield
Principal port
Populated places
Managua—258,758
Over 250,000
25,000 to 100,000
5,000 to 25,000
Under 5,000
Scale 1:1,500,000
Kilometers
Nautical Miles
Statute Miles
Lambert Conformal Conic Projection, Standard Parallels 9° and 17°
Honduras
El Salvador
Costa Rica
Pacific Ocean
Caribbean Sea
Tegucigalpa
Managua
Lago de Managua
Lago de Nicaragua
Nueva Segovia
Jinotega
Madriz
Estelí
Matagalpa
Chinandega
León
Boaco
Managua
Masaya
Carazo
Granada
Chontales
Zelaya
Río San Juan
Rivas
Puerto Cabezas
Bluefields
San Juan del Norte
Cabo Gracias a Dios
Golfo de Fonseca
CAYOS MISKITOS
Boundary representation is not necessarily authoritative
Base 504013 10-79 (544374)
88-693606
Central Intelligence Agency
G4850 1979 .U51
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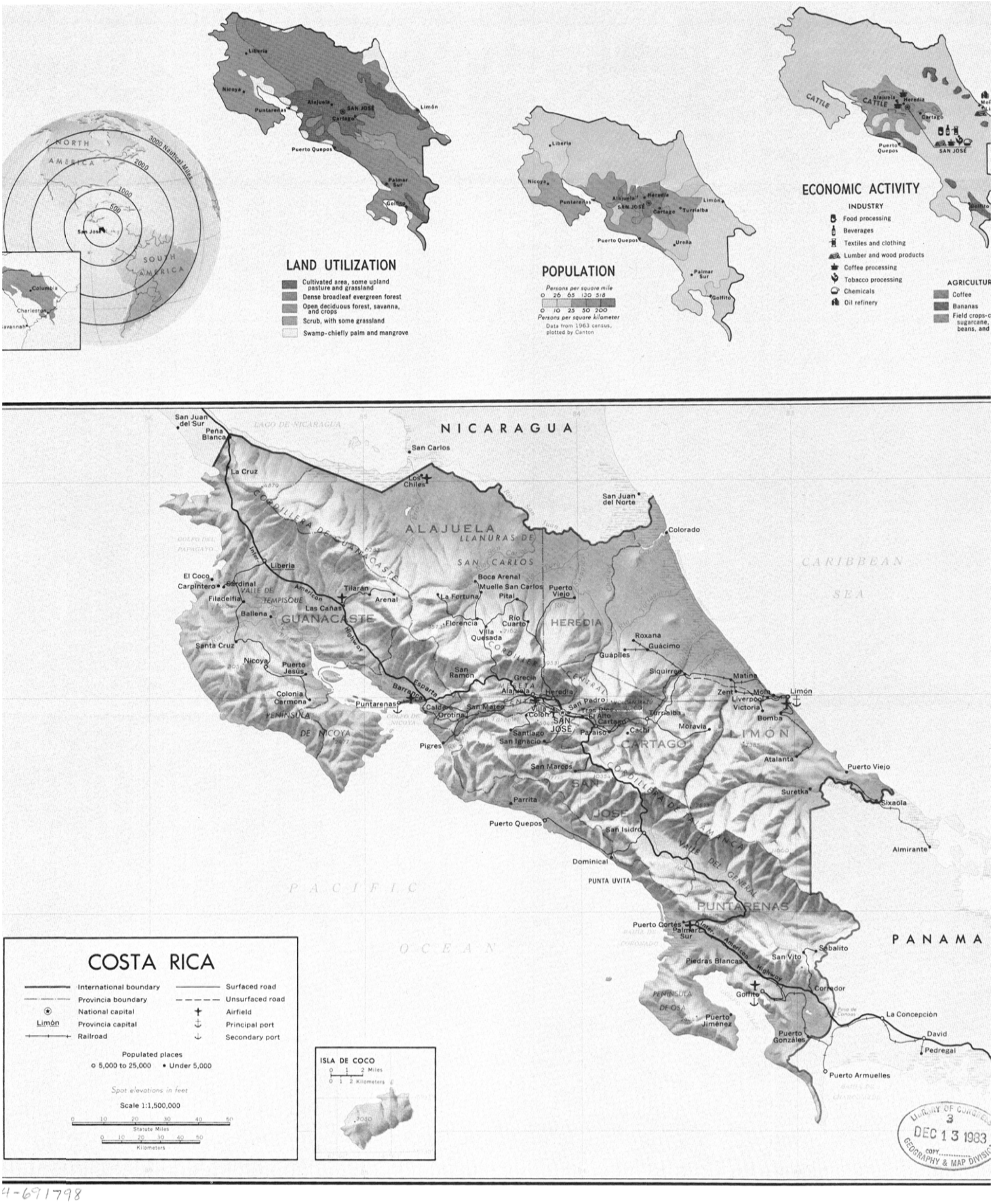
GEOGRAPHY & MAP DIVISION


San Juan
del Norte

Annex 129

Costa Rica, U.S. Central Intelligence Agency , 1983, G 4860 1983 U5


LAND UTILIZATION
Cultivated area, some upland pasture and grassland
Dense broadleaf evergreen forest
Open deciduous forest, savanna, and crops
Scrub, with some grassland
Swamp-chiefly palm and mangrove
POPULATION
Persons per square mile
0 26 65 130 518
0 10 25 50 200
Persons per square kilometer
Data from 1963 census, plotted by Canton
ECONOMIC ACTIVITY
INDUSTRY
Food processing
Beverages
Textiles and clothing
Lumber and wood products
Coffee processing
Tobacco processing
Chemicals
Oil refinery
NORTH AMERICA
SOUTH AMERICA
3000 Nautical Miles
NICARAGUA
San Juan del Sur
Peña Blanca
La Cruz
San Carlos
Los Chiles
San Juan del Norte
Colorado
ALAJUELA
LLANURAS DE SAN CARLOS
CORDILLERA DE GUANACASTE
CARIBBEAN SEA
Liberia
El Coco
Carpintero
Filadelfia
Ballena
GUANACASTE
Tilarán
Arenal
Las Cañas
Boca Arenal
Muelle San Carlos
Puerto Viejo
La Fortuna
Pital
Florencia
Villa Quesada
Río Cuarto
HEREDIA
Roxana
Guácimo
Guápiles
Santa Cruz
Nicoya
Puerto Jesús
Colonia Carmona
PENÍNSULA DE NICOYA
San Ramón
Grecia
Alajuela
Heredia
Siquirres
Matina
Limón
Zent
Moín
Liverpool
Victoria
Bomba
Puntarenas
Esparta
Barranca
Caldera
Orotina
San Mateo
Colón
SAN JOSÉ
San Pedro
Cartago
Turrialba
Moravia
Cachí
Paraíso
Santiago
San Ignacio
Pigres
CARTAGO
LIMÓN
Atalanta
Puerto Viejo
San Marcos
Suretka
Sixaola
Parrita
Puerto Quepos
San Isidro
CORDILLERA DE TALAMANCA
VALLE DEL GENERAL
Almirante
Dominical
PUNTA UVITA
PACIFIC OCEAN
PUNTARENAS
Puerto Cortés
Palmar Sur
PANAMA
Piedras Blancas
San Vito
Sabalito
Golfito
Corredor
PENÍNSULA DE OSA
Puerto Jiménez
Puerto Gonzales
La Concepción
David
Pedregal
Puerto Armuelles
COSTA RICA
International boundary
Provincia boundary
National capital
Limón
Provincia capital
Railroad
Surfaced road
Unsurfaced road
Airfield
Principal port
Secondary port
Populated places
5,000 to 25,000
Under 5,000
Spot elevations in feet
Scale 1:1,500,000
Statute Miles
Kilometers
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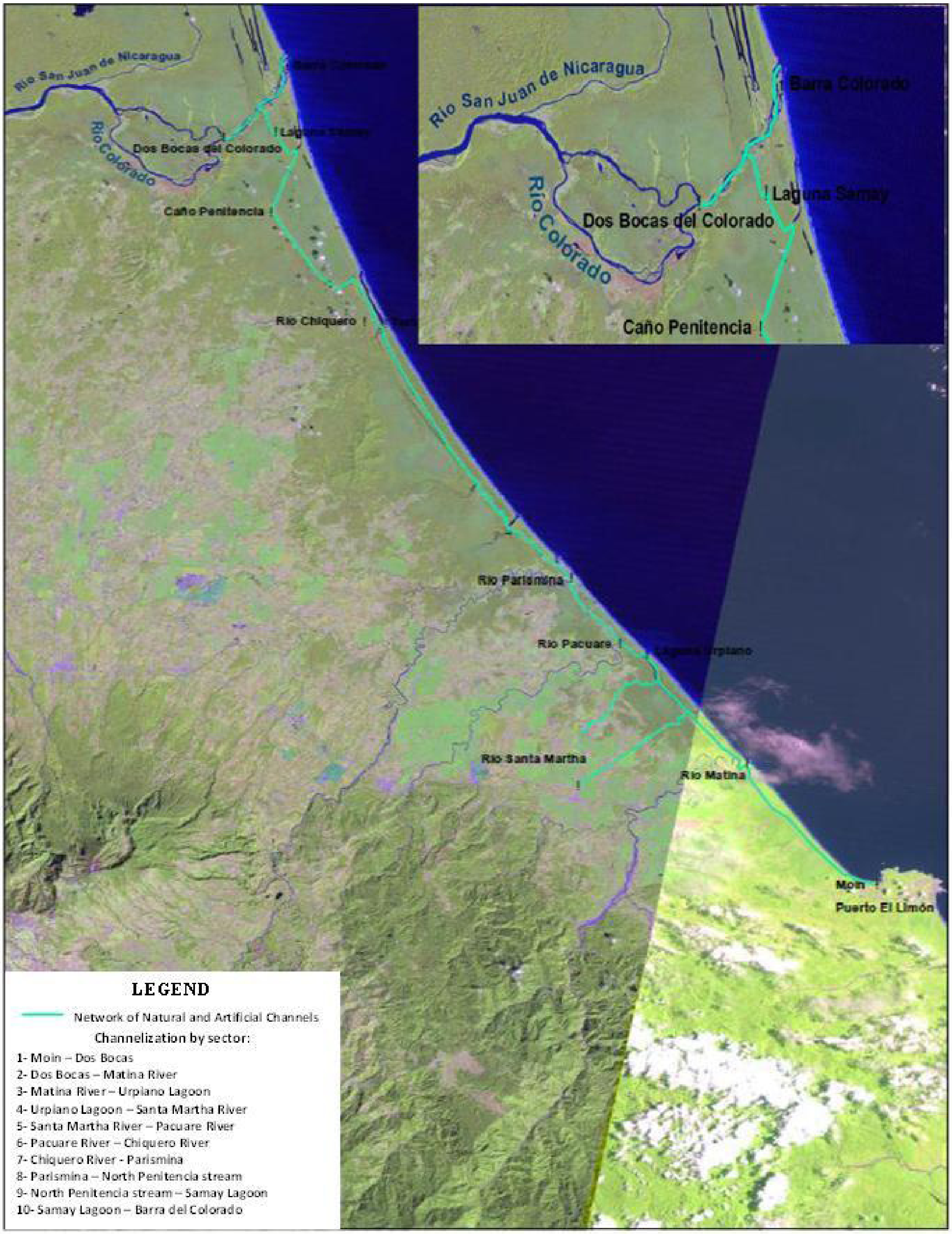
GEOGRAPHY & MAP DIVISION
4-691798


San Juan
del Norte

Annex 130

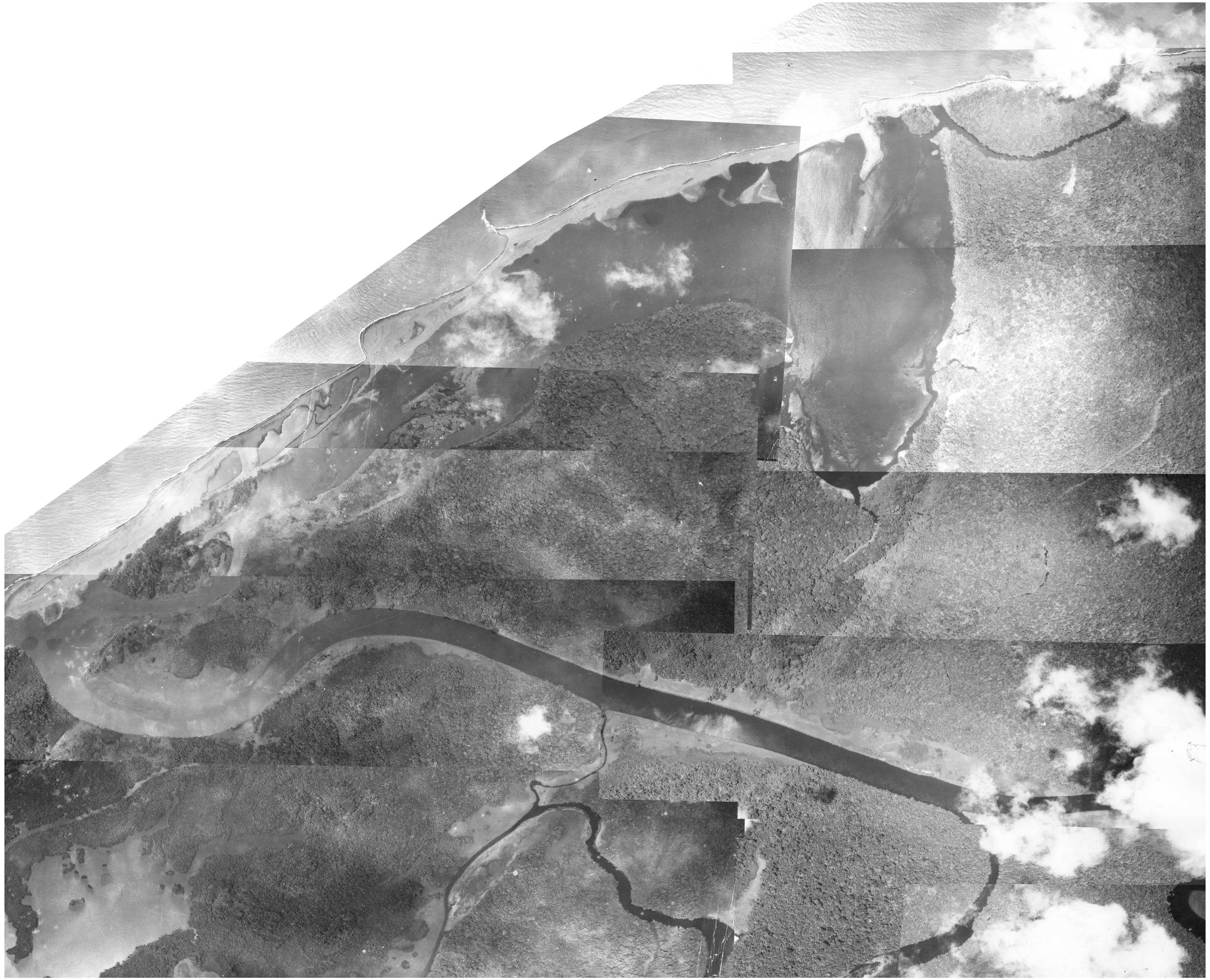
INETER Map of Costa Rican Navigation System

SITES DREDGED BY COSTA RICA
River navigation system between Moin and Barra de Colorado



Annex 131

1940 IMAGE



Annex 132

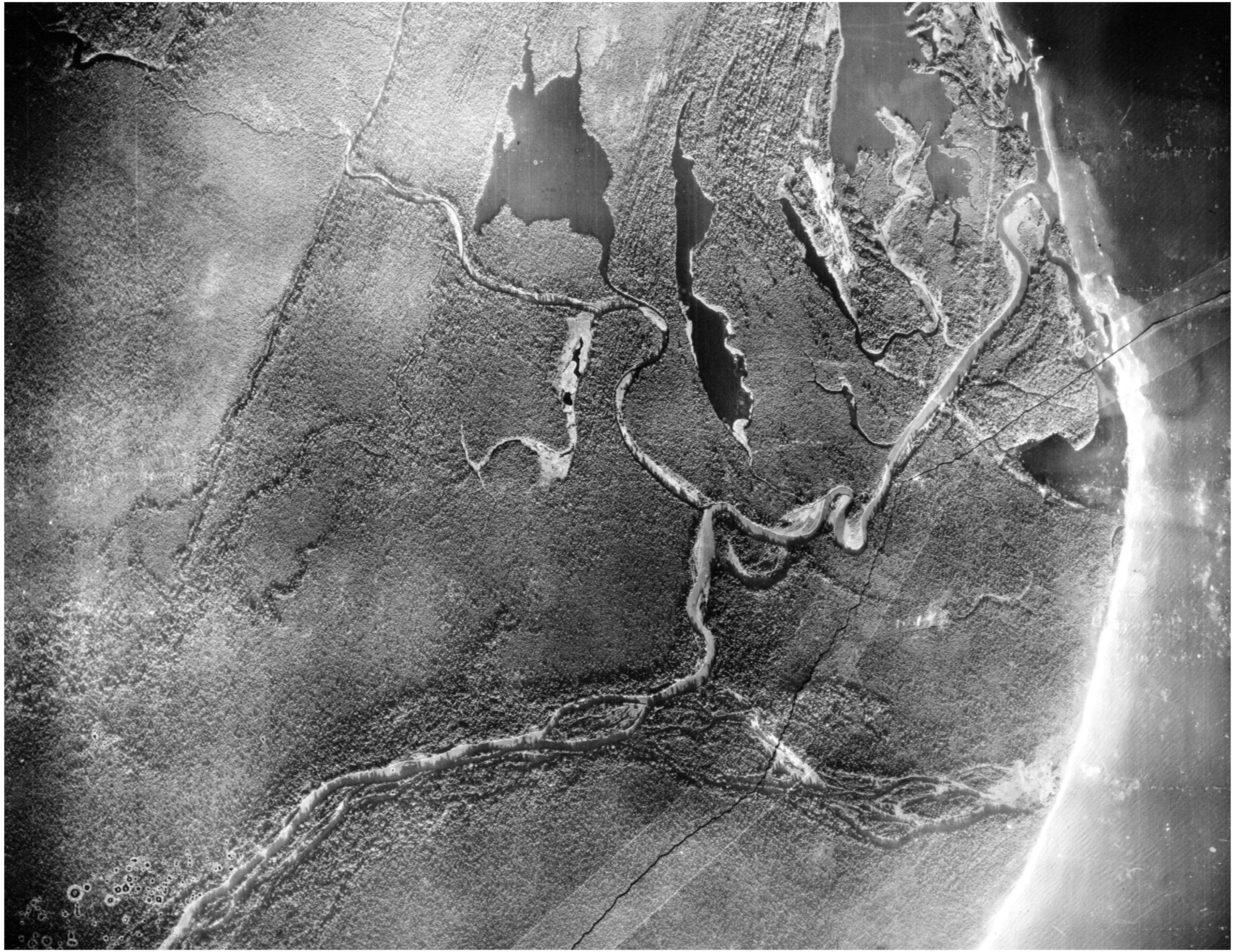
US Government, 12 January 1961

1961 Satellite Photograph

55 AM73, Roll 141, Line 64, Photo 5881, Scale 1.60 000, Date: 12 January 1961, Source: US Government.

Annex 133

1961 Aerial Image (2)



Annex 134

Government of Costa Rica, Terra Project, 13 December 1997

1997 SATELLITE PHOTOGRAPH

Source: Government of Costa Rica, Terra Project, 13 December 1997

Annex 135

2007 Satellite Photograph

Annex 136

2010 Satellite Image

Annex 137

Photograph of Trees requiring removal from the area adjacent to the caño
Source: Site visit by Ambassador Carlos Argüello on 09 September 2010

Annex 138

Photograph of trees and soil along the route of the road

Source: Site visit on the 1st of December, 2011.

Note: This photograph was taken from the San Juan River

Annex 139

Photographs of fragile soils removal

Source: El Nuevo Diario (The New Daily), Nicaragua, *"Costa Rican highway causes irreparable damage Ravage in the Río San Juan"* , 24 November 2011.

Source: http://www.elnuevodiario.com.ni/galeria/715-rio-san-juan#8119

Source: La Nación, Costa Rica. *«Acceleration of the Project one year after the Harbour Head conflict. Costa Ricans contruct a road parallel to the Río San Juan»,* 18 October 2011

Annex 140

Photograph of the modification of the drainage system.

Source; Site visit on the 1st of December, 2011.
Note: This photograph was taken from the San Juan River

Annex 141

Photograph of the destruction of the natural habitat

Source: El Nuevo Diario (The New Daily), Nicaragua
"Environmentalist corroborate damage by the Costa Rican road in Río San Juan on sight, Violation of sovereignty",
5 December 2011

Annex 142

Photographs of the destruction of the inherent scenic values
and eco-tourism potential of the San Juan River

Source; El Pais, Costa Rica *"Nicaragua complains for the construction of the road in Costa Rica",* 12 December 2011.

Source; Site visit on the 1st of December, 2011.