INTERNATIONAL COURT OF JUSTICE

DISPUTE CONCERNING CERTAIN ACTIVITIES CARRIED OUT BY NICARAGUA IN THE BORDER AREA

(COSTA RICA v. NICARAGUA)

MEMORIAL OF COSTA RICA

VOLUME IV
(Annexes from 139 to 165)

5 DECEMBER 2011

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Annex 139

Orville W. Childs. "Report of the survey and estimates of the cost of constructing the inter-oceanic ship canal, from the harbour of San Juan del Norte, on the Atlantic, to the harbour of Brito, on the Pacific, in the State of Nicaragua, Central America, made for the American, Atlantic and Pacific Ship Canal Co., in the Years 1850-1851-52." (New York: WM, C. Bryant, Printers, 1852), p.83.

Available at:
http://books.google.com/books?id=UOBXNRiR5KwC&dq=Front%20Cover%20Orville%20Whitmore%20Childs%2C%20John%20D.%20Fay%2C%20American%20Atlantic%20and%20Pacific%20Ship%20Canal%20Company&hl=es&pg=PA83#v=onepage&q&f=false

Wm. Chadwick

From J L White

REPORT

OF THE

SURVEY AND ESTIMATES

OF THE COST OF CONSTRUCTING THE

INTER-OCEANIC SHIP CANAL,

FROM THE

HARBOR OF SAN JUAN DEL NORTE, (GREYTOWN,) ON THE ATLANTIC

TO THE

HARBOR OF BRITO, ON THE PACIFIC,

IN THE

STATE OF NICARAGUA, CENTRAL AMERICA,

MADE FOR THE

AMERICAN, ATLANTIC AND PACIFIC SHIP CANAL CO.,

IN THE YEARS 1850-51-52.

BY

ORVILLE W. CHILDS, CHIEF ENGINEER.
J. D. FAY, PRINCIPAL ASSISTANT.

NEW YORK:
WM. C. BRYANT & CO., PRINTERS, 18 NASSAU STREET.

1825.

done, it can only be observed that the largest proportion of the fall is supposed to have occurred in the night. The fall is almost invariably by showers of short duration, which mostly occur in the latter part of the day and in the night.

The average annual fall of rain and snow, in the State of New York, during the period of ten years preceding that of 1846, as appears from the annual report of the Regents of the University of that year, is 34.14 inches, and the greatest fall in any year, during the same period, was 37.04 inches, and the least 32.10 inches.

Although the aggregate fall of rain in the month of May, 1850, as appears from the above statement, was 9.14 inches, there was no sensible rise in the river or lake until the 5th of June. The quantity of water that passed from the lake when at its greatest depression on the 4th of June last, as ascertained from a careful guage of the river at its minimum flow, was 11,930 cubic feet per second. The flow in the San Juan, immediately above the junction of the San Carlos River, as guaged on of the river at its minimum flow, was 11,930 cubic feet per second. The flow in the San Juan, immediately above the junction of the San Carlos River, as guaged on the 15th of July, was 19,300, in the San Carlos at the same time, 16,447, making the whole quantity flowing in the San Juan, below the San Carlos, 35,747 cubic feet per second. On the 8th of August, the quantity passing in the San Juan, above the Serapiqui, was 39,526, and in the Serapiqui 13,266, giving to the San Juan, below the Serapiqui, 52,792 cubic feet per second. The flow in the San Juan, immediately above the Colorado, as guaged on the 20th of August, was 54,380 cubic feet per second, of which 42,056 passed through the Colorado branch to the ocean, and 12,324 through the San Juan. Subsequent to the 5th of June, the river was more affected by rains, and on the 19th September, at the taking of the last observations previous

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Nicaragua Canal Commission "Report of the Nicaragua Canal Commission, 1897-1899", (Baltimore: The Lord Baltimore Press, 1899) p.260-261.

Available at: http://www.archive.org/stream/reportnicaragua00walkgoog#page/n18/mode/2up

REPORT

OF THE

NICARAGUA CANAL COMMISSION

1897-1899

REAR ADMIRAL JOHN G. WALKER, U. S. N.
PRESIDENT

COLONEL PETER C. HAINS, U. S. A.
Corps of Engineers

PROFESSOR LEWIS M. HAUPT
Civil Engineer

WITH AN ATLAS

The Lord Baltimore Press
THE FRIEDENWALD COMPANY
BALTIMORE
1899

RECORD OF RIVER GAGINGS FOR VELOCITY AND VOLUME.

Taken from Appendix C of Report of Nicaragua Canal Board, 1895.

River.	Locality.	Date.	Authority.	Area of cross sec. (sq. ft.).	Velocity per sec. (ft.).	Discharge per sec. (cu. ft.).	Remarks.
San Juan	Fort San Carlos	June 5, 1850	O. W. Childs	......	......	11,930	Lake Nicaragua at an elevation 103.07, low stage.
"	Immediately above mouth of San Carlos River	July 15, 1850	"	......	......	19,300	Medium stage.
"	Immediately below mouth of San Carlos River	July 15, 1850	"	......	......	35,747	" "
"	Immediately above mouth of Sarapiqui River	Aug. 8, 1850	"	......	......	39,526	" "
"	Immediately below mouth of Sarapiqui River	Aug. 8, 1850	"	......	......	52,792	" "
"	Immediately above head of Colorado River	Aug. 20, 1850	"	......	......	54,380	" "
Colorado River	....	Aug. 20, 1850	"	......	......	42,056	" "
Lower San Juan	....	Aug. 20, 1850	"	......	......	12,324	" " Ele. of Lake Nicaragua Sept. 19, 1850, 105.63.
San Juan	Above Toro Rapids	April 26, 1873	Lull	......	......	12,096	Ele. of Lake Nicaragua, 102.28, low stage.
San Juan	Below mouth of Poco Sound	April 30, 1873	"	......	......	11,390	" "
"	Above mouth of Santa Cruz	May 1, 1873	"	......	......	11,630	" "
"	Below mouth of Santa Cruz	May 2, 1873	"	......	......	12,453	" "
"	Above Mico Rapids	May 6, 1873	"	......	......	13,043	" "
"	Above mouth of San Carlos	May 10, 1873	"	......	......	13,206	" "
"	Above mouth of Sarapiqui	May 16, 1873	"	......	......	14,573	" "
"	Below mouth of Sarapiqui	May 16, 1873	"	......	......	16,770	" "
Colorado	....	May 19, 1873	"	......	......	16,190	" "
Lower San Juan	....	May 20, 1873	"	......	......	607	" "
San Juan	Between mouth of San Carlos and Ochoa	May 21 to 26, 1888	Canal Co., by J. H. Covode	11,310	3.665	41,451	Medium stage.

RECORD OF RIVER GAGINGS FOR VELOCITY AND VOLUME.—Continued.

River.	Locality.	Date.	Authority.	Area of cross sec. (sq. ft.).	Velocity per sec. (ft.).	Discharge per sec. (cu. ft.).	Remarks.
San Juan	Fort San Carlos	May 27, 1895	Nic. Canal Board	7,480	......	9,420	Lake at elev. 101.07 ft., velocities meas'd with floats immersed 5'; low stage, coefficient, 0.9.
"	Below mouth of Sarapiqui	June 20, 1895	"	21,500	3.50	60,200	Using surface velocity low stage, coefficient, 0.8.
San Carlos	Immediately above mouth	July 15, 1850	O. W. Childs	......	......	16,447	Medium stage.
"	....	Nov. 20, 1888	Canal Co. by J. F. Le Baron	......	......	7,844	" "
Sarapiqui	Immediately above mouth	Aug. 8, 1850	O. W. Childs	......	......	13,266	" "
Danta	300' above mouth	Mar. 21, 1888	Canal Co. by J. F. Le Baron	87.5	0.40	35	Low stage.
"	"	July 16, 1888	"	611	1.25	764	High stage.
San Francisco	Below mouth of Chanchos	Mar. 23, 1888	"	290	0.60	174	Using surface velocity, low stage.
"	Camp San Francisco	June 14, 1895	Nic. Canal Board	221	1.70	376	" "
"	200' below Camp San Francisco	June 14, 1895	"	303	1.05	318	" "
"	Below mouth of Chanchos	June 15, 1895	"	515	1.30	669	" "
Nicholson	Embankment Crossing	June 14, 1895	"	100	1.70	170	" "
Chanchos	"	June 15, 1895	"	209	1.60	334	" "
Limpio	Just below Camp Carmen	June 15, 1895	"	45	1.30	58	" "
"	At Camp Carmen	June 15, 1895	"	34	1.90	65	" "
"	Just above junction with the Lindo	June 16, 1895	"	9	1.80	16	" "
Lindo	Just above junction with Limpio	June 16, 1895	"	10.4	1.60	17	" "
Deseado	New site of Virginia Dam	June 17, 1895	"	50	3.00	150	" "
"	1500' below Camp Menocal	June 18, 1895	"	277	2.30	637	" "
"	Near Camp No. 7	June 18, 1895	"	484	1.5	727	" "
"	Near Lock No. 1	Dec. 14, 1892	Canal Co., by Boyd Ehle	......	......	285	Water surface elevation 13.26, medium stage.

Annex 141

The Annotated Ramsar List of Wetlands of International Importance: Costa Rica.

Available at: http://www.ramsar.org/cda/en/ramsar-pubs-annolist-annotated-ramsar-16460/main/ramsar/1-30-168%5E16460_4000_0__

10 January 2000

The Annotated Ramsar List: Costa Rica

22/05/2010

The Annotated Ramsar List of Wetlands of International Importance

COSTA RICA

The Convention on Wetlands came into force for Costa Rica on 27 April 1992. Costa Rica presently has 12 sites designated as Wetlands of International Importance, with a surface area of 569,742 hectares.

site; date of designation; region, province, state; surface area; coordinates
site; date de désignation; région, province, état; superficie; coordonnées
sitios; fecha de designación; región, provincia, estado; área; coordenadas

Caño Negro.*27/12/91;* Alajuela; 9,969 ha; 10º52'N 084º45'W. Part of the International System of Protected Areas for Peace; National Wildlife Refuge. A shallow freshwater lagoon near the Nicaraguan border, surrounded by seasonally inundated marshes and woodland. Part of an important network of Nicaraguan and Costa Rican wetlands used seasonally by many species of breeding or migrating waterbirds. The site supports small numbers of the endangered stork, *Jabiru mycteria*,important populations of the reptile *Caiman crocodilus fuscus* and the fish *Atractosteus tropicus*. A scientific research station is maintained. Ramsar site no. 541. Most recent RIS information: 1991.

Cuenca Embalse Arenal.*16/03/00*; Guanacaste, Alajuela; 67,296 ha; 10º30'N 084º51'W. Includes Protected Areas. A predominantly human-made lacustrine wilderness area, the site plays a significant hydrological, biological and ecological role in the natural functioning of the Embalse Arenal water catchment in the central part of the country. It holds special value for one or more endemic species or communities of flora and fauna in each of seven protected areas and contains 1,131 species of flora, 884 of them of potential ornamental use. It contains populations of endemic bromelia *Pitcairnia funckiae* and sustains threatened and endangered species of fauna, such as the mammals*Tapirus bairdii* (Baird's tapir) and *Leopardus pardalis* (ocelot), and birds such as*Cephalopterus glabricollis* and the *Amazilia boucardi* hummingbird. The wetland provides benefits related to hydropower generation, irrigation, tourism (water sports), recreational fishing and consumption, grazing, domestic agriculture and irrigation, agriculture and aquaculture. A management plan was implemented in 1997. Approximately 80% of the existing legislation is being enforced to regulate activities in the wetland and other protected areas. Environmental education programs are being implemented to involve organized groups, farmers, community leaders, teachers and schoolchildren in the search for better opportunities for the wise use of natural resources. Ramsar site no. 1022. Most recent RIS information: 2000.

Gandoca-Manzanillo.*11/12/95;* Limón; 9,445 ha; 09º37'N 082º40'W. Wildlife Refuge. A coastal lagoon consisting of coral reefs, seagrass beds, beaches and cliffs with flooded lowland areas between. The vegetation forms an unusual association of swamp forests composed of "yolillo" *Raphia taedigera* and *Camnosperma panamensis*, *Prioria coparifera*, and some mangroves. An important area for nesting sea turtles inhabiting the Caribbean. The site supports a high diversity of species, some of which are endangered or threatened, including birds, reptiles, molluscs and fish (marine, estuarine and freshwater), crustaceans, including lobster and 32 coral species. The fishery is an important source of revenue for local inhabitants. The site is part of the Talamanca-Caribe Biological Corridor and shares a border with Panama. Ramsar site no. 783. Most recent RIS information: 1995.

Humedal Caribe Noreste. *20/03/96;* Limón y Heredia; 75,310 ha; 10º30'N 083º30'W. The wetland includes lakes, grassmarshes, wooded swamps, gullies, streams and backwaters of large rivers as well as estuarine lagoons. The wetland area is the main stopover and entrance to Costa Rica for most Neotropical migratory birds, and the eagle*Morphnus guianensis,* the second largest bird of prey, has been recorded in the area. There are also several species of salamanders thought to be endemic to the area. The area is used largely for agriculture, and cattle ranching, tourism and fishing are also important activities. Ramsar site no. 811. Most recent RIS information: 1996.

Humedal Maquenque. *22/05/10*; Alajuela; 59,692 ha; 10°40'N 084°08'W. Located in northern Costa Rica and includes the total area of the National Wildlife Refuge Maquenque and the intermediate zone of the National Wildlife Refuge Biological Border Corridor Nicaragua-Costa Rica. The Ramsar Site consists of a lagoon complex and palustrine ecosystem distinctive of the very humid tropical ecoregion and characterized by its high biodiversity and support to endangered species such as the Lapa Verde (*Ara ambigua*), vulnerable species such as the Manatí (*Trichechus manatus*) and other important species such as the Jaguar (*Panthera onca*) and Pez Gaspars (*Atractosteus tropicus*). Furthermore, the wetland has an important hydrological value on the functioning of the surrounding basins. The main threats are from agricultural and forestry activities focused near the Colpachí and Manatí Lagoons. Both Protected Areas that form the site have a management plan focusing on conservation activities. Ramsar Site no. 1918. Most recent RIS information: 2010. Español

Isla del Coco. *21/04/98;* 99,623 ha; 5º32'N 086º59'W. World Heritage site; National Park. The island is of volcanic origin and its highest point is 634 m above sea level with 7,000 mm of rainfall per year. There are two plant associations, one the evergreen forest with South

American similarity, on the hilly areas, and a coastal one (dominated by a sedge *Hypolitum amplum*). It is considered to be one of the areas of highest endemism in the country, with five endemic vertebrate species and 16% of the plant species. Surrounding the island there are coral reefs, with 18 species and more than 300 fish species, which in some areas reach concentrations of 1,500-24,000 individuals/km2. A shelter for pirates during the 17^{th} and 18^{th} century. The site includes a swampy, coastal zone, a cloud forest and mountainous areas. The area is important for the reproduction of certain species, and large numbers of waterbirds nest in the area. The primary tourist activity is diving. Ramsar site no. 940. Most recent RIS information: 1998.

Laguna Respringue. *06/05/99;* Guanacaste; 75 ha; 10º52'N 085º51'W. The only freshwater swampy lagoon on the North Pacific coast of the country, the oldest part of Central America (said to be 88-200 million years old). The vegetation is dominated by*Phragmites* in most of the site. It has the driest climate in the country, and the strong winds of November-March have created very high dunes, in pristine condition. The site is relatively unaffected by human activities, largely because of the difficulty of access. Excessive agricultural and timber exploitation some 30 years ago were problematic, but the site is said to be recovering well. The site is especially important for capturing sediments. Present human uses include private farms and an environmental education programme in nearby Guanacaste. Ramsar site no. 982. Most recent RIS information: 1999.

Manglar de Potrero Grande.*06/05/99;* Guanacaste; 139 ha; 10º50'N 086º46'W. An area of near-pristine dry mangrove forest of uncommon alluvial origin along the mostly undeveloped north Pacific coast, adjacent to an important area of primary forest. Several types of threatened mangroves are present. The site is recovering successfully from exploitative practices that ended some 30 years ago; because of the establishment of forest reserves in 1977, there are few human uses, though some sporadic tourism occurs despite the difficulty of access. Ramsar site no. 981. Most recent RIS information: 1999.

Palo Verde. *27/12/91;* Guanacaste; 24,519 ha; 10º20'N 085º20'W. Added to the**Montreux Record**, 16 June 1993. National Park. Extensive estuarine complex of permanent, shallow, freshwater lagoons, associated marshes and seasonally flooded woodland and mangroves of the lower Tempisque River. An extremely important area for various species of nesting, staging and wintering waterbirds, Nearctic-breeding species, the stork *Jabiru mycteria* and in the dry season up to 20,000 *Dendrocygna autumnalis*. Other fauna include iguana and two species of crocodiles. Human activities in the surrounding area include rice and sugar-cane cultivation. Added to the Montreux Record in 1993 because of a major fire. Subject of a Ramsar Advisory Mission in 1998. Boundaries extended in September 2002. Ramsar site no. 540. Most recent RIS information: 2001.

Tamarindo. *09/06/93;* Guanacaste; 500 ha; 10º19'N 085º50'W. National Wildlife Refuge. A coastal area under tidal influence with permanent saline wetlands subject to seasonal flooding. About 80% of the area is mangrove forest, 75% of which are the red mangrove. Provides habitat for large numbers of waterbirds; reptiles include iguana and two species of crocodiles. Main land uses consist of traditional and recreational fishing, ranching, agriculture and commerce. Ramsar site no. 610. Most recent RIS information: 1993.

Terraba-Sierpe.*11/12/95;* Puntarenas; 30,654 ha; 08º52'N 083º36'W. Forest Reserve, National Wetland. The estuary of two rivers, adjacent lagoons, periodically inundated mangrove and "yolillo" palm swamp forest, sandy beaches and cliffs. Supports 55 species of fish, several commercial shellfish species, numerous bird species, mammals and reptiles. Human activities within the site consist of extraction of mangroves for fuel and tannins, traditional fishing, clam and crab harvesting. Ramsar site no. 782. Most recent RIS information: 1995.

Turberas de Talamanca. *02/02/03*. San José, Cartago, Limón provinces. 192,520 ha. 09º30'N, 083º42''W. National Parks, Forest Reserve, Biological Reserve. A unique high mountain wetland (altitude 700-3821m) located in the Talamanca mountain range and considered an extremely heterogeneous area in terms of the ecosystems present: non-forested peatlands, paramos, meadows, cloud forests, and rain forests. The protected areas comprising the Ramsar site make up an immense biological corridor that allows numerous vulnerable animal species to move about in search of food and breeding sites, among them the Central American tapir *Tapirus bairdii*, the ocelot *Felis pardales*, and the red brocket *Mazama americana*. Numerous plant communities are present in the site's different ecosystems present - *paramos*, oak forests, and non-forested peatlands.*Paramos* are found between 2900-3100 meters above sea level, and contain a unique mixture of neotropical flora, including holartic, Andean, and endemic species, which show important adaptations to extreme conditions, seasonality, and high solar radiation. Oaks are the dominant feature in what is regarded as the country's largest forest mass, most notably the IUCN Red-Listed black oak *Quercus costaricencis* and the hook*Quercus corrugata*. Peatlands are "drowned" and thus are characterized by Ciperaceae, Juncaceae, Ericaceae, large ferns of the Blechnaceae family, plus *Sphagnum* and other mosses. The hydrological network in Tapantí National Park is of vital importance for Costa Rica in terms of hydroelectric power production and supply of a large portion of the drinking water for the country's largest cities. Chirripó National Park features the country's tallest mountain, Cerro Chirripó (3820m above sea level), as well as rare geomorphologic formations of glacial origin. The largest indigenous group in Costa Rica, the Bribri, are native to the mountains of Talamanca, thus giving the site a great cultural importance. Ramsar site no. 1286. français et/y español Most recent RIS information: 2003.

Annex 142

The Annotated Ramsar List of Wetlands of International Importance:
Nicaragua.

Available at:
http://www.ramsar.org/cda/en/ramsar-pubs-annolist-annotated-ramsar-16106/main/ramsar/1-30-168%5E16106_4000_0__

31 January 2000

The Annotated Ramsar List: Nicaragua

18/10/2011

The Annotated Ramsar List of Wetlands of International Importance

NICARAGUA

The Convention on Wetlands came into force for Nicaragua on 30 November 1997. Nicaragua presently has 9 sites designated as a Wetland of International Importance, with a surface area of 406,852 hectares.

site; date of designation; region, province, state; surface area; coordinates
site; date de désignation; région, province, état; superficie; coordonnées
sitios; fecha de designación; región, provincia, estado; área; coordenadas

Cayos Miskitos y Franja Costera Immediata. *08/11/01*; Atlántico Norte; 85,000 ha; 14°23'N 082°46'W. Marine Biological Reserve. Offshore Caribbean island and shoals and adjacent mainland coastal areas 12km to the west, comprising an impressive array of wetland types, principally frequently-flooded areas dominated by shrubs, riverine systems in which are found gallery forests, and estuaries bordered by mangrove forests in near-natural state. At the Cayos Miskitos Reserve, there is one of the largest extensions of sea grass in the Caribbean, intermingled with coral reefs, areas which support several rare and endangered species, including the Green Turtle (*Chelonia mydas*), Hawksbill Turtle (*Eretmochelys imbricata*), the Caribbean manatee (*Trichechus manatus*), the "Tucuxi" freshwater dolphin *Sotalia fluviatilis*, and caiman crocodile (*Crocodylus fuscus)*. The Association of Indigenous Women of the Costa Atlántica recently initiated a promising ecotourism project. Ramsar site no. 1135. Most recent RIS information: 2001.

Deltas del Estero Real y Llanos de Apacunca. *08/11/01*; Chinandega; 81,700 ha; 12°53'N 087°13'W. Natural Reserve. An estuarine ecosystem that is part of the large mangrove systems of the Golfo de Fonseca shared with El Salvador and Honduras, marked by semi-intensive and extensive shrimp cultivation, fishing, and agriculture. Within the site some 35 species of fauna have been identified, and part of the site was declared a Reserve for Genetic Resources in 1996 in order to preserve a species of wild maize (*Zea luxurians* or *nicaraguensis*) that is endemic to Nicaragua and found only in this area. The original diversity of the site has suffered from human impacts such as agrochemical and organic waste, sedimentation, deforestation, and excessive hunting. Ramsar site no. 1136. Most recent RIS information: 2001.

Lago de Apanás-Asturias.*08/11/01*; Jinotega; 5,415 ha; 13°10'N 085°58'W. An artificial lake or reservoir formed by two electricity-producing barrages of the Río Tuma in the mountainous north of the country, characterized by seasonally flooded agricultural land, water storage areas, and canals for transport and drainage. The endangered Perro de Agua "water dog" (Plata Otter, *Lutra longicaudis*) is supported, and the site is also important for a number of aquatic birds and for fish, a number of which have high economic value in the area. The site has high potential for ecotourism because of its migratory birds and artisanal fishing practices, and recreational and educational potentials are high as well. Ramsar site no. 1137. Most recent RIS information: 2001.

Los Guatuzos.*30/07/97;* 43,750 ha; 11º00'N 084º52'W. Lakes and ponds subject to seasonal flooding, set in alluvial depressions with surrounding woodlands. There are also areas that are normally dry where the water table is several centimetres below the surface. The interaction of unique environmental factors has given rise to rich populations of flora and fauna both indigenous and migratory. 326 bird species, of which 77 species are migratory, 32 mammal and 10 reptile species are supported. There are several species of birdlife threatened with extinction. Ramsar site no. 915.Most recent RIS information: 2001.

Refugio de Vida Silvestre Río San Juan. *08/11/01*; Río San Juan, Atlántico Sur; 43,000 ha; ca.10°56'N 083°40'W. Wildlife Refuge, Biosphere Reserve. A long, slender, convoluted site that follows the course of the Río San Juan, which flows from Lake Nicarague at 32m altitude along the Costa Rican frontier 200km to the city of San Juan del Norte on the Caribbean coast, and includes the coastline to the north as well, part of the Biosphere Reserve Indio Maiz, forming one of the two most extensive biological nuclei of the Mesoamerican Biological Corridor. The site comprises an array of wetland types, including estuary and shallow marine waters, coastal freshwater lagoon, and intertidal marsh, as well as permanent lakes, rivers, and pools, *inter alia*. Nearly all of the Ramsar Criteria are met, and four species of turtles, as well as the manatee Trichechus manatus, are supported. Ramsar site no. 1138. Most recent RIS information: 2001.

Sistema de Humedales de la Bahía de Bluefields. *08/11/01*; Atlántico Sur; 86,501 ha; 11°55'N 083°45'W. Added to the Montreux Record, 15/01/07. Comprising a diversity of ecosystems from saline to freshwater, encompassing the "bay", which is in fact a coastal lagoon associated with the Río Escondido. The intertidal forested areas and mangroves form habitat and biological corridors for endangered larger animals, such as the jaguar (*Pantera onca*), Central American Tapir or "Danta" (*Tapirus bairdii*), the howling monkey *Alouatta fusca*, and ocelot *Leopardus pardalis*. The system is regenerating despite the devastation of Hurricane Joan in 1988. The site is extremely important for the artisanal fishing which forms the economic and cultural base of the ethnic groups in the area. Problems associated with population growth and pollution pose threats, though several communities have organized a group of communal park-wardens. Subject of a **Ramsar Advisory Mission** in December 2005 and added to the Montreux Record on 15/01/07. Ramsar site no. 1139. [**Signs**] Most recent RIS information: 2001.

Sistema de Humedales de San Miguelito. *08/11/01*; Río San Juan; 43,475 ha; 11°25'N 084°51'W. Situated along the southeast coast of Lago Cocibolca (Lake Nicaragua, the largest lake in Central America), the site maintains a rich biological diversity, supporting a large number of species of birds, fish, reptiles and mammals. It also performs essential functions in the prevention of natural disasters, in purifying and recycling the water of the lake, and in regulating local climate. Ramsar site no. 1140. Most recent RIS information: 2001.

Sistema Lacustre Playitas-Moyúa-Tecomapa. *29/06/11*; Matagalpa; 1,161 ha; 12°35'47"N 086°02'48"W. Comprises a permanent lake and two seasonal freshwater lakes, intermittent rivers, swamps, and the flooded agricultural lands that surround them. The site is among the 10 most important wetlands in Nicaragua due to its hydrological importance as the only surface water reservoir in one of the driest areas of the country, which also ensures its biological importance as it supports a diversity of mammals, reptiles, fish, and birds. Migratory species include the blue-winged teal (*Anas discors*), which uses the site as a rest area, endangered species according to IUCN Red List as lignum-vitae (*Guaiacum sanctum*), and fish species representative of the region. In addition, the site supports important activities for the population such as fisheries and agriculture. Among the main factors which could adversely affect the site's ecological character are the extraction of water for livestock and agriculture, overfishing, and poaching, among others. The site has a management and development plan approved in 2006. Ramsar Site no. 1980. Most recent RIS information: 2011. Español.

Sistema Lagunar de Tisma. *08/11/01*; Managua, Granada; 16,850 ha; 12°04'N 085°56'W. A number of small lake, marsh, and river shore ecosystems associated with the northwest shores of Lake Nicaragua. The sites supplies water for cattle grazing, rice cultivation, and irrigation of pastures, recharges groundwater and assists in flood control, retains sediments and contaminants, and supports a number of species of migratory birds. Inhabitants of the site benefit by meat and fish and derive fiber materials for the fabrication of handkerchiefs, mats, fans, and other handicrafts. Rice cultivation and resulting alterations of water level and agrochemical effects have a direct impact upon the site. The Audobon Society Nicaragua and the IUCN Mesoamerica Office assisted in preparation of the designation and in the ongoing development of a management plan, with support from the government. Most recent RIS information: 2001.

Annex 143

Sistema Nacional de Áreas de Conservación (SINAC), Ministry of Environment, Energy and Telecommunications of Costa Rica, Report, Ref: ACTO-RNVSBC-CyP-057-2010

22 October 2010

NATIONAL SYSTEM OF CONSERVATION AREAS
TORTUGUERO CONSERVATION AREA
BARRA DEL COLORADO NATIONAL WILDLIFE REFUGE ADMINISTRATION

SINAC

MINAET
Ministerio de Ambiente, Energía y Telecomunicaciones

GUAPILES,22nd OF OCTOBER 2010
ACTO- RNVSBC-CyP-057-2010

Mrs
Laura Rivera Quintanilla.
a.i Director ACTo

PRELIMINARY
INSPECTION REPORT

On the 22nd of October of 2010, the Control and Surveillance officer for the RNVSBC (Barra del Colorado National Wildlife Refuge), jointly with Biologist Edwin Lezama of the Barra del Colorado Coastguard, patrolled the San Juan river area where there is evidence of dredging by the government of Nicaragua, specifically, the western part of the Portillos lagoon.

At approximately 2 p.m. they took off from the Barra del Colorado airstrip in a Law Enforcement helicopter headed for the above mentioned area, and after a 10 minute flight arrived at Nº 10.91646”---W083º83.67984” on the margin of the San Juan River, where the following was observed:

1. There are sand and mud sediment deposits that are not characteristic of the area’s wetlands, which are undoubtedly part of the materials drained out of the river as part of the dredging operations, and which have been deposited at this site. This area is 2,625 m^2.

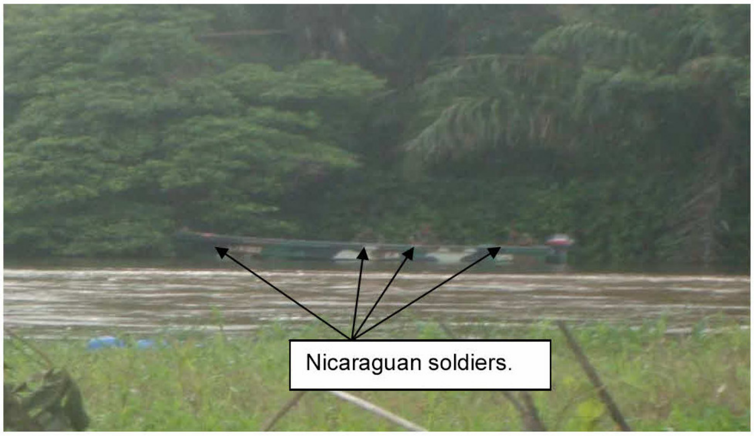
This sand is a result of sediment deposits from the dredging.

2. Near the sediment deposits area is a *Spondias Mombin* tree measuring 52 cm in diameter and 14 meters in height and 1 189 m^3, which has been cut down.

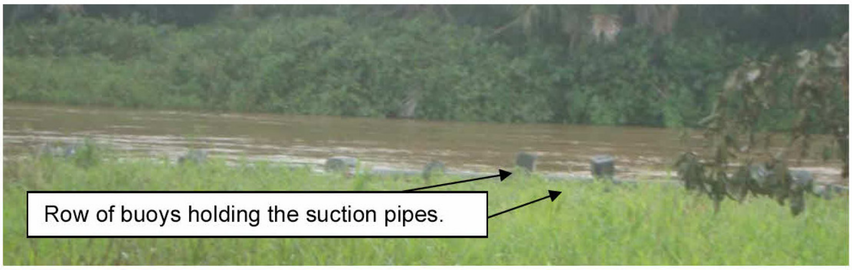
3. There is a canal or track on Costa Rican soil left by the dredger's drainage pipes, which deposited sediments from the river. Due to their muddy nature, sediments made it impossible to walk around the area and made it impossible to safely reach the edge of the river.

4. There is a barge (named Soberan [sic]) of about 15 meters in length, on which the suction dredger is installed, and where at least 5 armed Nicaraguan soldiers and approximately 6 civilians were observed. It is worth mentioning that this vessel is moored on the Costa Rican side and tied to a tree on Costa Rican soil using a thick blue rope.

5. There is another vessel approximately 200 meters away from the barge, on the other bank of the river, belonging to the Nicaraguan army, with four armed soldiers and facing Costa Rican soil.



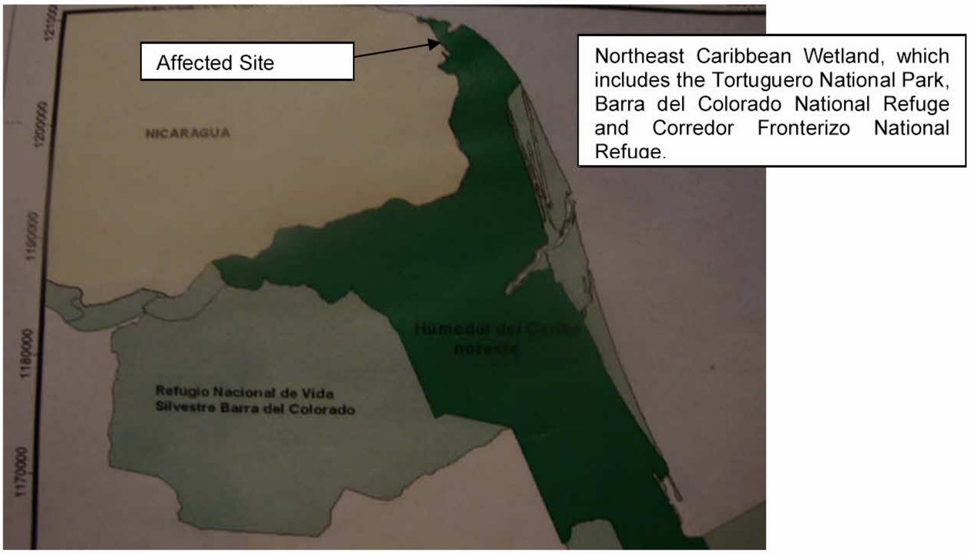
6. A row of large buoys is observed along the edge of the river, off Costa Rican soil, and which hold the suction pipes, with a distance of approximately 80 meters.



7. Approximately 1000 meters away from the dredger's location towards the Northeast is a large area of approximately 5 hectares that was felled (change of soil use) and where the forest was completely eliminated, with a large number of trees knocked down and a pile of cut wood. It is important to visit this site again in order to take measurements for an appraisal of the environmental damage.

GPS Point N 10.92377º ---W083.68121º

8. This entire area belongs to the Corredor Fronterizo (Border Corridor) Costa Rica-Nicaragua National Wildlife Refuge, and is part of the Northeast Caribbean wetlands, declared an internationally important Ramsar Site, ecosystems protected by Law of the Republic of Costa Rica.



9. At the time of the inspection, at least 15 Law Enforcement Officers, the Deputy Prosecutor for the Second District Court of the Atlantic Area, Mr Celso Gamboa, and a Chancellery Officer, Mr Arnoldo Brenes.

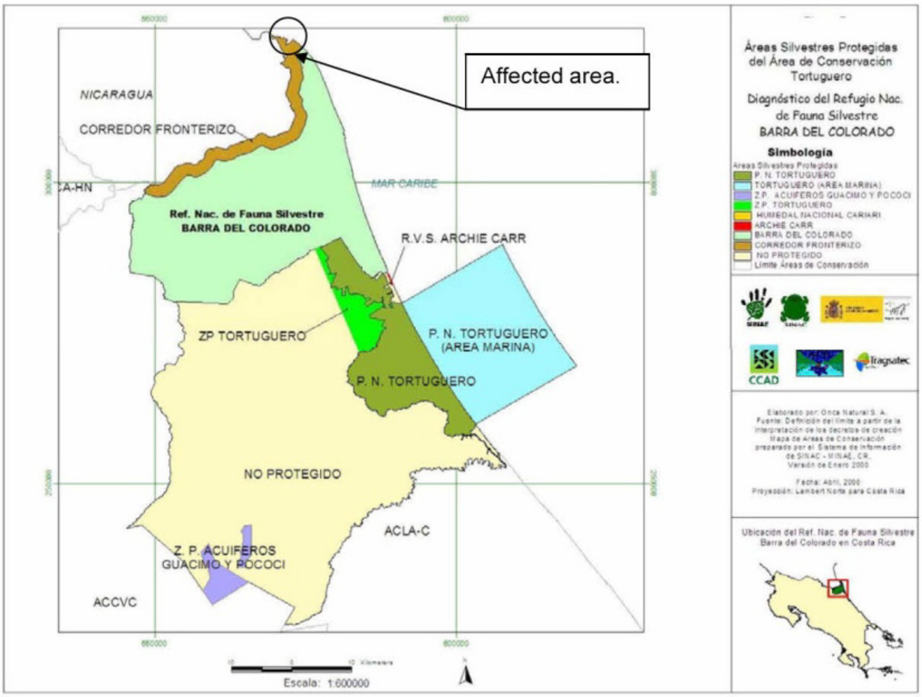


Figure showing the Tortuguero Conservation Area and the affected area.

10. We collaborated with Prosecutor Celso Gamboa by providing technical information required by the Prosecutor's Office in order to draw up the pertinent report.

The visit ended at 4:30 p.m. heading back to the Barra del Colorado South area, but a brief flyover of the felled forest area was done first, where pictures and geographic positioning data were taken.

Recommendations:

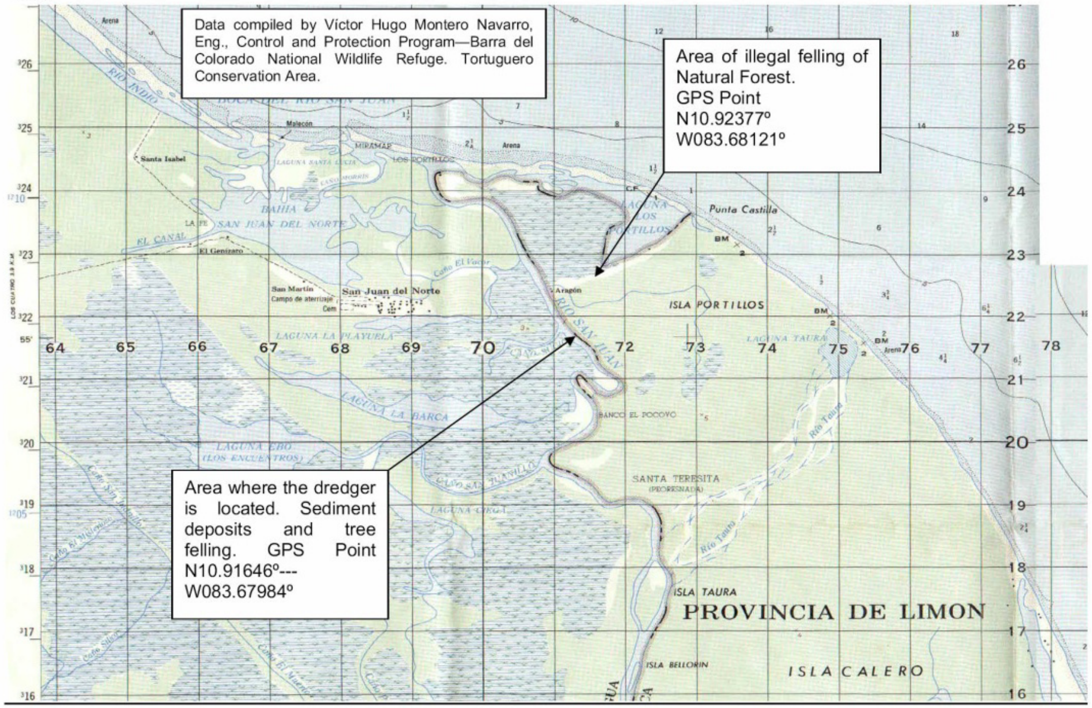
1. Perform another visit to the area of the dispute, going down to the site for the purpose of measuring the felled areas and appraising the environmental impact.
2. Identify and appraise other potential damages caused to the area of the dispute, by means of a flyover, with the assistance of the Law Enforcement's Air Unit.

YOURS FAITHFULLY:

Víctor Hugo Montero Navarro, Eng.
Cedula (Identification Number) 9-083-814
Control and Protection Program. Barra del Colorado National Wildlife Refuge. ACTo

c.c.
Erick Herrera Quesada.
Administrator Barra del Colorado National Wildlife Refuge.
María Elena Herrera. Manager Wildlife Protected Lands-ACTo
Virgita Molina S. Legal Consultancy.
Celso Gamboa. Pococí's Prosecutor's Office.
File.

NATIONAL SYSTEM OF CONSERVATION AREAS
TORTUGUERO CONSERVATION AREA
BARRA DEL COLORADO NATIONAL WILDLIFE REFUGE ADMINISTRATION



Mission Statement: SINAC (National System of Conservation Areas) integrally oversees the conservation and sustainable management of wildlife, forestry resources, wildlife protected areas, water basins and water systems, working jointly with public figures for the benefit of current and future generations

Phone: (506)27102929 / Fax: (506)27107673 / Email: acto@ice.co.cr,/ www.acto.go.cr

Año Internacional de la Diversidad Biológica

Annex 144

OAS, Report by the Secretary General on his visit to Costa Rica and Nicaragua, Ref: CP/doc.4521/10 corr.1. Available at:

http://www.oas.org/en/media_center/press_release.asp?sCodigo=E-15

9 November 2010

PERMANENT COUNCIL

OEA/Ser.G

CP/doc.4521/10 corr. 1

12 November 2010

Original: Spanish

REPORT BY THE SECRETARY GENERAL OF THE OAS ON HIS VISIT TO

COSTA RICA AND NICARAGUA

Presented to the Permanent Council at its special meeting of

November 9, 2010

Report of the Secretary General of the OAS

José Miguel Insulza

on his visit to Costa Rica and Nicaragua

November 9, 2010

Washington, D.C.

On November 2, 2010, the Government of Costa Rica, in accordance with Articles 21 and 62 of the Charter of the Organization of American States (OAS), urgently requested that a special meeting of the Permanent Council be convened on Wednesday, November 3, "owing to the entry of the armed forces of the Republic of Nicaragua into Costa Rican territory in the San Juan River border zone." The document may be found in the relevant annex.

On November 3, 2010, the special meeting of the Permanent Council came to order as requested. Present was the Minister of Foreign Affairs and Worship of the Republic of Costa Rica, Mr. René Castro, who gave a presentation of the facts that prompted his government's request.

At the meeting, the Permanent Representative of Nicaragua to the OAS, Ambassador Denis Moncada, also took the floor to set out the position of his government on the issue in hand, arguing that the supposed violation of territory had not occurred and that his country's services personnel and citizens had remained at all times in Nicaraguan territory.

The Chair of the Permanent Council informed that body that Costa Rica and Nicaragua agreed "to provide an opening to enable the Secretary General to undertake efforts in a bid to overcome the situation" and, in this context, they extended an invitation to the Secretary General to visit their respective countries and subsequently to submit a report to the Permanent Council today on the results of those visits.

To that end, I visited Costa Rica from November 5 to 8, 2010, to hear the positions of both governments, obtain information in situ about the matter, and make overtures to the respective governments in an attempt to find a way toward dialogue and detente by which to create opportunities for understanding on the problems that had arisen along the border. In addition to myself, the delegation consisted of Dr. Dante Caputo, special advisor to the Secretary General; Dr. Dante Negro, Director of the Department of International Law; Mrs. Patricia Esquenazi, Press Director; Mr. Antonio Delgado, specialist from the Secretariat for Political Affairs; and Ms. Ana Matilde Pérez-Katz, advisor to the Secretary General.

In the course of our visit to Costa Rica, which was where we went first, the Secretary General met President Laura Chinchilla; the Minister of Foreign Affairs, René Castro; the Minister of the Interior, Police and Public Security, José Manuel Tijerino, and Ambassador José Enrique Castillo, together with their respective retinues. Also at the first meeting with the President were authorities from the other branches of government, including the Vice President, the President of the Supreme Court of Justice, the Speaker of the Legislative Assembly, and the Vice Minister of the Office of the President.

I should mention that prior to the meeting with the President, on the night of our arrival, a briefing was held at which most of the representatives mentioned above were present along with their retinues. Having concluded this first visit, we traveled to Nicaragua.

In the course of the visit to Nicaragua we twice met, on successive days, President Daniel Ortega, who was accompanied by the First Lady, Rosario Murillo; the Minister of Foreign Affairs, Samuel Santos; the Chairman of the Joint Chiefs Of Staff, General Julio César Avilés; the Permanent Representative to the OAS, Ambassador Denis Moncada, and other important figures in the Nicaraguan government. In the course of this visit and between the two meetings with the President, we had the opportunity to tour the San Juan River border zone in the company of senior Nicaraguan officials, the Chairman of the Joint Chiefs of Staff, and a number of other persons.

We completed our visit to Nicaragua –I repeat that there was a second talk with President Ortega and his retinue– and returned to Costa Rica where we gathered for a briefing on the points of view that we have heard. We then had a second meeting with President Chinchilla. Prior to that we made a visit to the San Juan River border zone from the Costa Rican side.

I would like to thank the authorities of Costa Rica and Nicaragua for the openness and trust with which our endeavors were met and, in particular, by the collaboration and facilities that I was afforded during the visit to perform this delicate task. In truth, everyone was willing to assist us whenever we needed logistical support. There were no difficulties with the helicopters in which we traveled to the border nor with any other activity that we wished to carry out.

The meetings with the two countries included presentations on geographical, historical, and political issues, setting out the perspectives of either country on the matter. We listened to the points of view of both parties. It should be recalled that the mandate of this Secretary extends no further than goodwill efforts to create a space for negotiation between the parties, and in no circumstances to expound on or discuss, much less resolve, the underlying issue. The border question that has arisen is a matter between Costa Rica and Nicaragua and they are the sovereign actors who must decide how they settle it. Our desire is to ensure that they do so amicably, using peaceful dispute settlement mechanisms. Our mission, therefore, is not to negotiate boundaries; it is a good offices mission to seek a peaceful settlement of the dispute.

For that reason, I believe it important to mention that in the course of all these discussions and having listened very closely to the points of view of the parties as to why they believed that they were each right in their positions, we discovered the existence of potential openings for understanding. I would like to mention these openings for understanding

One: The authorities of both countries said that the discussion over the San Juan River and the factors concerning the environment, security, and border development that it concerns, have been a recurring theme in their bilateral relations. They said that although the situation has become tense in the present climate, there is no desire whatever that it escalate into confrontation. In this regard, both parties repeatedly expressed their interest in giving priority to dialogue in addressing the situation.

Two: The Binational Commission was recognized as the appropriate institutional framework for addressing concerns of mutual interest. The presidents of both countries made clear their willingness to attend a bilateral meeting in the near future and in that framework to engage in direct dialogue with a representative of the OAS Secretary General in attendance. Costa Rica insisted on the need to tackle the present differences in order then to proceed with the work of the Binational Commission, while Nicaragua, on the other hand, urges that the issues be addressed in the framework of the Binational Commission with our participation.

Three: Costa Rica indicated that it shares Nicaragua's interest in protecting the border area from drug and arms trafficking, as well as combating organized crime therein, which has intensified in recent years and worsened in the border zone due to a lack of guard posts. Both countries evinced concern at this situation, which poses a risk to institutions throughout Central America, and indicated the need to confront it jointly. Both countries have expressed their interest in implementing joint cooperation plans in the area, although within the limits, capabilities, and rights of either on the San Juan River.

Areas were also identified in which it would certainly be possible to achieve greater rapprochement, for which dialogue is highly essential.

Four: They concurred on the importance of protection of the environment. Costa Rica said that the dredging work, silt dumping, and clear cutting to make way for roads that Nicaragua is carrying out will affect the environment in Costa Rica. Nicaragua, however, has argued that the work that it is doing will help to raise the water level of the San Juan River, which runs dry for several months of the year, helping also to benefit Costa Rica and sustainable development in the region. I believe that discussion and progress on this subject will be possible, as will holding a dialogue that leads to a joint border development agreement which serves the interests of both countries and governs any measures that they might carry out to develop the region.

As regards aspects concerning the frontier line, Nicaragua regards this issue as a priority since it maintains that there are sections that have yet to be marked. Indeed, the Binational Commission created many years ago to place boundary markers has not completed the process. It is, therefore, in the interests of both countries to finish the frontier demarcation process in those areas where it is still pending, in accordance with the legal instruments in force between the two parties.

Based on these agreements and in view of the fact that during this visit to Costa Rica and Nicaragua both governments ratified their firm commitment to peace in the region and their belief in candid and direct dialogue between the two nations as the only possible way to address crucial aspects of their bilateral agenda, I am of the view that progress in that direction would come about if Costa Rica and Nicaragua were to adopt the following accords:

One: Hold the Eighth Meeting of the Binational Commission in order to address as a matter of urgency aspects of the bilateral agenda as soon as possible and no later than the date originally agreed, with the assistance of the OAS.

Two: Immediately resume the talks on aspects concerning the demarcation of the boundary line in accordance with the treaties and decisions in force.

Three: In order to create a favorable climate for dialogue between the two nations, avoid the presence of military or security forces in the area, where their existence might rouse tension.

Four: To instruct the appropriate authorities to review and strengthen cooperation mechanisms between the two nations in order to prevent, control, and confront drug trafficking, organized crime, and arms trafficking in the border area.

This commitment would reaffirm the manifest will to address any difference between sister nations in a peaceful way and would strengthen a broad opportunity for understanding and agreement to their mutual benefit.

Thank you

Annex 145

Sistema Nacional de Áreas de Conservación (SINAC), Ministry of Environment, Energy and Telecommunications of Costa Rica, Report

"Appraisal of maximum average age of the trees felled in primary forest areas in the Punta Castilla, Colorado, Pococí and Limón sectors of Costa Rica, as a result of the Nicaraguan Army's occupation for the apparent restoration of an existing canal".

December 2010

"Appraisal of maximum average age of the trees felled in primary forest areas in the Punta Castilla, Colorado, Pococí and Limón sectors of Costa Rica, as a result of the Nicaraguan Army's occupation for the apparent restoration of an existing canal"

Miguel Araya Montero[1]

Introduction

At the end of October of this year, Costa Rica's Government, through officials from the Ministry of Public Safety and the Tortuguero Conservation Area, noticed environmental damages in the Northern sector of Calero Island, specifically, in the Punta Castilla area known as Portillos Island, which is part of the Colorado district, of the Pococí canton, Limon province. In what concerns the National System of Conservation Areas (SINAC), the affected area is located in the Tortuguero Conservation Area (ACTo) and within the wildlife protected area Corredor Fronterizo Norte (Northern Border Corridor) National Wildlife Refuge.

Initially, the damages observed were a result of the operation of the Nicaraguan dredger named "Soberanía" on the Costa Rican margin of the San Juan River. Furthermore, sediment deposits as an apparent result of the dredging of the San Juan River on Costa Rican Soil and a track that was established between the area of the sediment deposits and an area of forest that had been entirely felled were observed.

As a result of the damages observed and prior to military occupation of the affected area by members of the Nicaraguan Army, officers of the Ministry for Public Safety and the Tortuguero Conservation Area visited the affected area and measured the perimeter of the sites and took a census of the trees cut in the area of forest that was felled in its entirety. In what specifically concerns the felled forest section, it was a primary forest where 197 trees were cut. These trees had diameters that ranged between 5 and 130 centimetres

[1] Forestry Management Program Officer for the Tortuguero Conservation Area, SINAC, Costa Rica

projected on the basis of the cut, in an area of 1.67 hectares. In an adjacent area that forms a band around the one where the forest was felled, and which measures approximately 4.08 ha, the elimination of all undergrowth was also observed.

A few days after the incursion mentioned in previous paragraphs, the Nicaraguan Army was observed using the affected areas and following up on their operations there. Among the arguments used to justify the occupation, they pointed out that the work on the San Juan riverbed and the damages to Costa Rican soil were aimed at clearing out an existing channel or mouth of the San Juan River.

Based on the above, this document is aimed at proving, through an appraisal of the maximum average age of the trees felled, that specifically in the forest area where the trees were cut, there has been no canal during the last few decades.

Objective

To indirectly estimate, using the times of passage methodology, the maximum average age of the trees felled in primary forest areas located in the Punta Castilla, Colorado, Pococí, Limón sectors of Costa Rica, which are occupied by the Nicaraguan Army.

Technical Aspects

Natural Tropical Forests are ecosystems that are far from static. Instead, they are dynamic ecosystems whose rate of change is dictated by the fall of old trees, due to their own plant conditions or induced by external factors of anthropogenic or natural origin, such as forestry or strong winds, among others (Fredirecksen, et al, 2001)

The falling of a tree is the mechanism that clears the forest canopy to allow new plants to grow and in time interact and colonize this clearing until the canopy closes over again.

Fredirecksen, et al, 2001, establish that normally the forest canopy clears between 1-5% yearly due to natural causes; however this figure may vary according to the unique environmental conditions of a specific ecosystem; for example, Peralta, et al, 1987, quoted by Valerio and Salas, 1998, determined that in a Costa Rican forest 25% of the forest opens up in clearings each year.

Thus the amount of time passed since the opening of a clearing determines the age and maximum dimensions of the trees growing therein, taking into account that the soil and climate characteristics determine the forest structure, since this structure is the ecosystem's best response to the environmental characteristics and limitations and threats that its environment poses (Valerio and Salas, 1998).

Due to the various ecologic interactions occurring in different forests, each forest has its own characteristic behaviour, where the general model for the distribution of the number of trees per diameter class tends to behave like an inverted J, where, as diameter increases the number of trees decreases (Valerio and Salas, 1998). The theoretical distribution of the number of trees per diameter class in forests with trees of various ages is described by De Liocourt's Law (Fredirecksen, et al, 2001).

Dance and Malleux, 1976, established that one of the most difficult things to determine about natural forests is their age, however, this can be determined by the correlation between tree diameters and annual increases, by implementing data from permanent sampling plots or by means of forest inventories.

Since the early nineties, in Costa Rica there have been several efforts aimed mainly at studying the behaviour of primary forests under forestry management. These efforts are led by research and training centres such as CATIE (Tropical Agricultural Research and Higher Education Centre) and the Universidad Nacional de Costa Rica and Instituto Tecnologico de Costa Rica Universities, as well as NGOs such as FUNDECOR

(Foundation for the Development of the Central Volcanic Range) and CODEFORSA (Commission of Forestry Development) in Costa Rica's northern areas.

Thus, Redondo, et al, 2001, established that for the period of time determined for the measurement, the forests studied grew between 2.2 – 5.4 mm/yearly for all trees with diameters greater than 5 cm.

Meza and Mendez, 2006, as part of a study with permanent plots carried out in Northern Costa Rica, established that trees in the diameter range between 30 – 40 centimetres grow at rates of 0.51 mm/yearly, 0.23 mm/yearly and 0.17 mm/yearly if their crowns are dominant, intermediate or suppressed, respectively; considering that the time of passage of these trees will be 77, 110 and 151 years, according to their crown exposure.

In Costa Rica's southern areas, Meza, et al, no date, in a Study named Age of Managed and Unmanaged Forests in Costa Rica's Humid Tropic, established that unmanaged forests have a yearly growth rate of 0.64 cm/yearly, whereas disturbed forests have a yearly diameter growth that reached 1.17 cm/yearly.

Methodology

Because of the lack of periodic measurements in the forested area located in the northern section of Calero Island that has been affected by Nicaraguan intervention, growth data for managed forests located in Costa Rica's northern areas were used, so as to approximate average diameter growth and use this data as a basis for estimating the maximum age of trees in the affected area.

A reference point used for estimating the average diametric growth was the Study carried out by Quesada, 2003, named "*Dinámica del Crecimiento Diamétrico del Bosque Tropical Intervenido de Bajura*" (Dynamics of Diametric Growth in Lowland Disturbed Tropical Forests), which is based on measurements of permanent sampling plots located in forests in the Boca Tapada area of San Carlos, which is very close to the San Juan River. The above mentioned Study determines the time of passage for the whole span based on the measured increases for three different management units. It is worth noting that these forests were dynamized as a result of the interventions they were subject to, unlike the affected forest area, which shows no evidence of prior interventions.

Table 1 shows current yearly increases measured using permanent sampling plots for three management units in the Ochoa, Boca Tapada, Pital, San Carlos area, Costa Rica.

Table 1. Current yearly increases measured using permanent sampling plots for three management units in the Ochoa, Boca Tapada, Pital, San Carlos area, Costa Rica.

Management Unit	Current Yearly Increase by Diameter Class (cm/year)						
	10-20	20-30	30-40	40-50	50-60	60-70	70-80
1	0.27	0.43	0.77	0.56	0.59	1.06	0.70
2	0.27	0.61	0.58	0.52	0.85	0.32	0.17
3	0.34	0.45	0.39	0.69	0.30	0.42	0.31

Source: Quesada, 2003

Based on the above table, a general current yearly increase average for the Study at hand was obtained, considering that the current yearly increase in average diameter is 0.50 cm/yearly, which, for a level of statistical reliability of 95%, would fluctuate between 0.40 cm/yearly and 0/61 cm/yearly.

The approximate maximum age of trees was obtained by dividing the average diameter for each class observed in the affected forest by the current yearly increase in average described in the previous paragraph.

Results

Using the data from the census taken in the affected area, the horizontal structure per hectare of the forest in question was drawn up and is summarized in the two following tables.

Table 2. Distribution of number of trees per hectare by diameter class observed within the 1.67 ha of forest felled in the Punta Castilla sector of Calero Island, Colorado, Pococí, Limón.

Scientific Name	Number of trees per hectare by diameter category in centimetres (n/ha)											
	<10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100>	Total
Casearea Sp		0.60										0.60
Ceiba pentandra							1.20					1.20
Unknown		4.79	0.60	0.60	0.60		0.60					7.19
Grias cauliflora		0.60	1.20	0.60								2.40
Inga sp		1.20	0.60									1.80
Lonchocarpus sp		0.60										0.60
Mimosaceae	0.60	2.40	0.60									3.59
Pachira aquatica		2.99	4.79	1.80	1.20			0.60				11.38
Pentaclethra macroloba		0.60			0.60		0.60					1.80
Pterocarpus officinalis		12.57	10.18	5.99	10.78	8.98	13.77	5.99	6.59	2.40	3.00	80.24
Raphia taedigera	Determined based on a stump count at the affected area											42.50
Simira maxonni		0.60	1.20									1.80
Simphonia globulifera		1.20	1.80		1.20							4.19
Spondias Bombin			0.60		0.60							1.20
Overall Total	0.60	28.14	21.56	8.98	14.97	8.98	16.17	6.59	6.59	2.40	3.00	160.46

Source: Census taken on 25th October 2010.

For the distribution shown in the above table, the following clarifications are made:

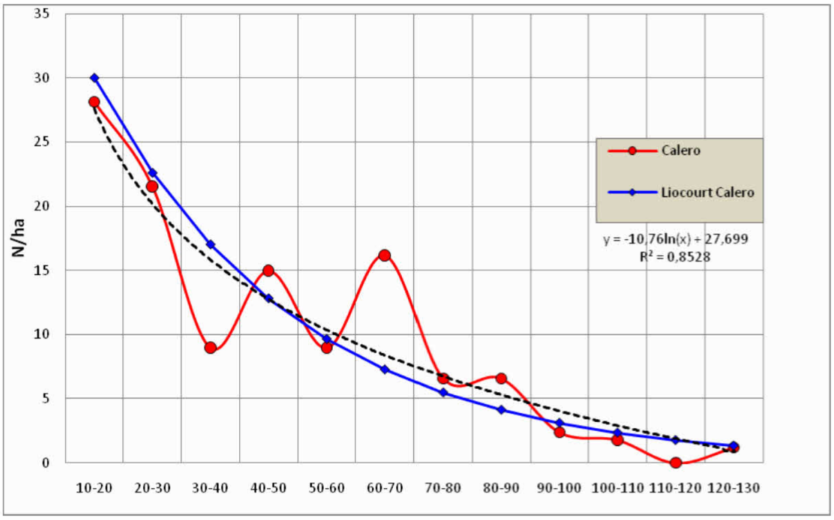
The number of trees per hectare for the *Raphia taedigera* species was obtained by counting the number of stumps and does not correspond to the number of stems that comprise the stumps observed.

Locating plants with diameters below 5 cm was made difficult by the presence of branches and residues from larger trees, which prevented an appropriate counting of plants of this size.

The previous table shows that the predominant species by number of trees per hectare is *P. officinalis*, followed by *R. taedigera* and *P. aquatica*, which are all species characteristic of flooded forests.

The following figure 1 is a graph of the behaviour of the population of the felled forest.

Figure 1. Comparison between the distribution of number of trees per hectare by diameter class observed within the 1.67 ha of forest felled in the Punta Castilla sector of Calero Island, Colorado, Pococí, Limón and the De Liocourt distribution and a regression model generated based on the data from the census.



Source: 25th October 2010 Census

The above figure shows how the behaviour of the population viewed (round marks) corresponds to a regression model with a high adjustability level (dotted line), which itself corresponds with the normal inverted J distribution expected for the forest in question.

Figure 3, below, shows the distribution of the basal area dislodged in the felled forest in hectares, except that *R. taedigera* was excluded from this distribution because this species was only counted.

Table 3. Distribution of the basal area per hectare by diameter class observed within the 1.67 ha of forest felled in the Punta Castilla sector of Calero Island, Colorado, Pococí, Limón.

Scientific Name	Basal Area per hectare by diameter class in centimetres (m^2/ha)										
	<10	10-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 >	Total
Casearea sp		0.005										0.005
Ceiba pentandra							0.386					0.386
Unknown		0.072	0.021	0.068	0.083		0.175					0.419
Grias cauliflora		0.009	0.059	0.042								0.110

Inga sp		0.026	0.025									0.051
Lonchocarpus sp		0.014										0.014
Mimosaceae	0.001	0.029	0.019									0.049
Pachira aquatica		0.045	0.197	0.159	0.174			0.251				0.826
Pentaclethra macroloba		0.012			0.075		0.169					0.257
Pterocarpus officinalis		0.192	0.442	0.550	1.480	1.966	4.111	2.304	3.350	1.541	3.001	18.938
Simira maxonni		0.011	0.056									0.066
Simphonia globulifera		0.015	0.071		0.182							0.268
Spondias Bombin			0.029		0.087							0.116
Overall Total	0.001	0.430	0.918	0.819	2.082	1.966	4.841	2.555	3.350	1.541	3.001	21.504

Source: 25th October 2010 Census

Based on the information shown in the previous tables and figures, it is considered that the felled forest has a tree age distribution that corresponds to the characteristics of a primary forest.

As determined previously, the current yearly increase for the model forest was 0.50 cm/yearly and that, for a 95% reliability level, it ranged between 0.40 cm/yearly and 0.61 cm/yearly. This information was used as the basis for creating table 4, shown below, which determines the approximate age of trees in the appraised forest for each diameter category based on the average diameter of each diameter class.

This was used to determine the average age of trees in diameter class between 10 to 20 centimetres and up to the 120 to 130 centimetres class, which comprises trees with the largest diameter observed in the affected area.

Table 4. Approximate minimal and maximum average age in years for average diameters of diameter classes observed in the 1.67 ha section of forest felled in the Punta Castilla sector of Calero Island, Colorado, Pococí, Limón.

Average diameter class (cm)	Approximate age (years)		
	Minimum	Average	Maximum
15	24.8	29.7	37.2
25	41.3	49.5	62.0
35	57.8	69.3	86.7
45	74.3	89.2	111.5
55	90.8	109.0	136.3

65	107.3	128.8	161.1
75	123.8	148.6	185.9
85	140.3	168.4	210.7
95	156.8	188.2	235.4
105	173.3	208.0	260.2
115	189.8	227.8	285.0
125	206.3	247.6	309.8

Table 3 shows that trees in the 10 to 20 cm diameter class could be on average 29.7 years old. This age could fluctuate between 24.8 and 37.2 years; however, this diameter class only makes up 2% of the total basal area observed for the affected area.

The diameter class that makes up the majority of the basal area is that ranging between 60 cm to 70 cm, which is just slightly over 22% of the total basal area. Trees in this class would be on average 128 years old, an age which could fluctuate between 107.3 and 161.1 years.

However, trees with diameters in the 120 to 130 centimetres class were observed in the appraised area, and these trees could be on average 247.6 years old, an age which could fluctuate between 206.3 and 309.8 years.

Based on the above, the precise age of the affected forest cannot be determined, however, the presence of trees on site that are over 200 years old can be proven, which implies the forest has existed for at least as long as that.

Conclusion

In the area of forest that was felled on Calero Island, in the area known as Isla Portillos, which, as of the 25th of October 2010 measured 1.67 ha, there were trees with diameters that suggest an age that might have ranged between 206.3 and 309.8 years, and thus it can be assumed that the affected forest could be at least as old as that.

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Table 4. List of trees in the census of the 1.67 ha of primary forest felled in the Punta Castilla, Isla Calero, Colorado, Pococí, Limón sector. Geographic coordinates shown in Projection CRTM05, referring to datum WGS84.

#	Longitude	Latitude	Species	Name	Diameter (cm)
1	534954	1207881	*Pterocarpus officinalis*	Sangrillo	55
2	534949	1207890	*Spondias mombin*	Jobo	43
3	534953	1207896	*Pterocarpus officinalis*	Sangrillo	70
4	534955	1207897	*Pachira aquatica*	Popenjoche	45
5	534962	1207887	*Pentaclethra macroloba*	Gavilán	40
6	534968	1207903	*Pterocarpus officinalis*	Sangrillo	65
7	534968	1207903	*Pterocarpus officinalis*	Sangrillo	40
8	534976	1207913	*Pterocarpus officinalis*	Sangrillo	11
9	534982	1207909	*Pterocarpus officinalis*	Sangrillo	25
10	534991	1207913	*Pterocarpus officinalis*	Sangrillo	50
11	534996	1207917	*Pachira aquatica*	Popenjoche	30
12	534996	1207919	*Pterocarpus officinalis*	Sangrillo	40
13	535000	1207926	*Pterocarpus officinalis*	Sangrillo	40
14	535002	1207929	*Pterocarpus officinalis*	Sangrillo	15
15	535008	1207925	*Pachira aquatica*	Popenjoche	20
16	535002	1207934	*Pachira aquatica*	Popenjoche	15
17	535000	1207936	*Pterocarpus officinalis*	Sangrillo	25
18	535000	1207944	*Pterocarpus officinalis*	Sangrillo	80
19	535003	1207954	*Pterocarpus officinalis*	Sangrillo	60
20	535003	1207954	*Pachira aquatica*	Popenjoche	15
21	535000	1207961	*Pachira aquatica*	Popenjoche	31
22	535003	1207963	*Pterocarpus officinalis*	Sangrillo	130
23	535007	1207962	*Pterocarpus officinalis*	Sangrillo	40
24	535014	1207964	*Pachira aquatica*	Popenjoche	20
25	535014	1207964	*Pachira aquatica*	Popenjoche	12
26	535010	1207959	*Pterocarpus officinalis*	Sangrillo	65
27	535010	1207959	*Pterocarpus officinalis*	Sangrillo	65
28	535015	1207971	*Pterocarpus officinalis*	Sangrillo	12
29	535019	1207972	*Pachira aquatica*	Popenjoche	24
30	535019	1207972	*Pterocarpus officinalis*	Sangrillo	22
31	535011	1207987	*Pterocarpus officinalis*	Sangrillo	40
32	535030	1207964	*Pterocarpus officinalis*	Sangrillo	20
33	535029	1207965	*Pachira aquatica*	Popenjoche	27
34	535029	1207965	*Pachira aquatica*	Popenjoche	13
35	535024	1207965	*Pachira aquatica*	Popenjoche	22
36	535027	1207960	*Pterocarpus officinalis*	Sangrillo	60
37	535027	1207960	*Pterocarpus officinalis*	Sangrillo	15
38	535027	1207960	*Mimosaceae*	Mimosaceae	15
39	535015	1207962	*Pterocarpus officinalis*	Sangrillo	20
40	535013	1207958	*Pterocarpus officinalis*	Sangrillo	10
41	535015	1207953	*Pterocarpus officinalis*	Sangrillo	20
42	535025	1207947	*Pterocarpus officinalis*	Sangrillo	50
43	535025	1207947	*Pterocarpus officinalis*	Sangrillo	70
44	535025	1207947	*Pterocarpus officinalis*	Sangrillo	10

45	535025	1207947	*Pachira aquatica*	Popenjoche	14
46	535031	1207944	*Pterocarpus officinalis*	Sangrillo	50
47	535031	1207944	*Mimosaceae*	Mimosaceae	10
48	535031	1207944	*Mimosaceae*	Mimosaceae	12
49	535035	1207944	*Simphonia globulifera*	Cerillo	20
50	535035	1207944	*Mimosaceae*	Mimosaceae	5
51	535038	1207947	*Pterocarpus officinalis*	Sangrillo	60
52	535036	1207951	*Pterocarpus officinalis*	Sangrillo	20
53	535036	1207951	*Simphonia globulifera*	Cerillo	10
54	535038	1207954	*Pterocarpus officinalis*	Sangrillo	80
55	535037	1207963	*Pterocarpus officinalis*	Sangrillo	60
56	535061	1207959	*Pterocarpus officinalis*	Sangrillo	80
57	535063	1207975	*Pterocarpus officinalis*	Sangrillo	90
58	535063	1207975	*Inga sp*	Guabilla	15
59	535063	1207975	*Inga sp*	Guabilla	18
60	535058	1207982	*Pachira aquatica*	Popenjoche	25
61	535056	1207982	*Pterocarpus officinalis*	Sangrillo	70
62	535065	1207979	*Pterocarpus officinalis*	Sangrillo	60
63	535060	1207980	*Pterocarpus officinalis*	Sangrillo	70
64	535058	1207991	*Pterocarpus officinalis*	Sangrillo	80
65	535058	1207991	*Mimosaceae*	Mimosaceae	20
66	535050	1207991	*Inga sp*	Guabilla	23
67	535050	1207991	*Pterocarpus officinalis*	Sangrillo	80
68	535046	1207991	*Pterocarpus officinalis*	Sangrillo	32
69	535046	1207991	*Pterocarpus officinalis*	Sangrillo	53
70	535049	1207994	*Pachira aquatica*	Popenjoche	24
71	535046	1208000	*Casearea sp*	Casearea	10
72	535046	1208000	*Grias cauliflora*	Tabacón	14
73	535046	1208000	*Pterocarpus officinalis*	Sangrillo	60
74	535040	1208001	*Simphonia globulifera*	Cerillo	24
75	535040	1208001	*Mimosaceae*	Mimosaceae	12
76	535032	1208002	*Pterocarpus officinalis*	Sangrillo	53
77	535028	1207992	*Pterocarpus officinalis*	Sangrillo	60
78	535056	1208001	*Pterocarpus officinalis*	Sangrillo	29
79	535058	1207998	*Pterocarpus officinalis*	Sangrillo	60
80	535062	1207997	*Pterocarpus officinalis*	Sangrillo	70
81	535071	1207979	*Pterocarpus officinalis*	Sangrillo	15
82	535071	1207979	*Pterocarpus officinalis*	Sangrillo	10
83	535074	1207978	*Pterocarpus officinalis*	Sangrillo	70
84	535074	1207972	*Pterocarpus officinalis*	Sangrillo	90
85	535074	1207972	*Grias cauliflora*	Tabacón	30
86	535075	1207967	*Pterocarpus officinalis*	Sangrillo	55
87	535075	1207967	*Pterocarpus officinalis*	Sangrillo	20
88	535079	1207969	*Pterocarpus officinalis*	Sangrillo	15
89	535081	1207967	*Pterocarpus officinalis*	Sangrillo	60

90	535078	1207961	*Pterocarpus officinalis*	Sangrillo	29
91	535081	1207963	*Pterocarpus officinalis*	Sangrillo	70
92	535085	1207965	*Pterocarpus officinalis*	Sangrillo	40
93	535087	1207968	*Pterocarpus officinalis*	Sangrillo	30
94	535091	1207966	*Pterocarpus officinalis*	Sangrillo	40
95	535091	1207966	*Pterocarpus officinalis*	Sangrillo	60
96	535092	1207968	*Pterocarpus officinalis*	Sangrillo	58
97	535096	1207968	*Pterocarpus officinalis*	Sangrillo	80
98	535096	1207968	*Grias cauliflora*	Tabacón	25
99	535100	1207980	*Pterocarpus officinalis*	Sangrillo	30
100	535102	1207984	*Pterocarpus officinalis*	Sangrillo	100
101	535106	1207989	*Spondias mombin*	Jobo	25
102	534931	1207898	*Pentaclethra macroloba*	Gavilán	60
103	534946	1207881	*unknown*	unknown	11
104	534947	1207887	*Pterocarpus officinalis*	Sangrillo	14
105	534948	1207901	*Pterocarpus officinalis*	Sangrillo	40
106	534956	1207908	*Pterocarpus officinalis*	Sangrillo	20
107	534988	1207924	*Pterocarpus officinalis*	Sangrillo	50
108	535001	1207943	*unknown*	unknown	15
109	535041	1207961	*Pterocarpus officinalis*	Sangrillo	70
110	535041	1207964	*Pterocarpus officinalis*	Sangrillo	55
111	535042	1207966	*Pterocarpus officinalis*	Sangrillo	80
112	535042	1207966	*Pachira aquatica*	Popenjoche	20
113	535033	1207985	*Pterocarpus officinalis*	Sangrillo	60
114	534919	1207900	*Pterocarpus officinalis*	Sangrillo	100
115	534930	1207904	*Pterocarpus officinalis*	Sangrillo	46
116	534928	1207908	*Pterocarpus officinalis*	Sangrillo	56
117	534928	1207920	*Pterocarpus officinalis*	Sangrillo	49
118	534936	1207915	*Pterocarpus officinalis*	Sangrillo	40
119	534936	1207905	*Pterocarpus officinalis*	Sangrillo	65
120	534937	1207919	*Pterocarpus officinalis*	Sangrillo	130
121	534943	1207927	*Pterocarpus officinalis*	Sangrillo	20
122	534947	1207921	*Pterocarpus officinalis*	Sangrillo	70
123	534948	1207921	*Pterocarpus officinalis*	Sangrillo	60
124	534949	1207922	*Pterocarpus officinalis*	Sangrillo	16
125	534954	1207919	*Pterocarpus officinalis*	Sangrillo	85
126	534962	1207937	*Pterocarpus officinalis*	Sangrillo	31
127	534961	1207942	*Pterocarpus officinalis*	Sangrillo	15
128	534961	1207942	*Pterocarpus officinalis*	Sangrillo	50
129	534961	1207945	*Pterocarpus officinalis*	Sangrillo	45
130	534951	1207956	*Pterocarpus officinalis*	Sangrillo	15
131	534958	1207963	*Pterocarpus officinalis*	Sangrillo	50
132	534961	1207962	*Pterocarpus officinalis*	Sangrillo	40
133	534961	1207962	*Pterocarpus officinalis*	Sangrillo	45
134	534966	1207966	*Pterocarpus officinalis*	Sangrillo	52

135	534968	1207969	*Pentaclethra macroloba*	Gavilán	16
136	534968	1207977	*Pterocarpus officinalis*	Sangrillo	60
137	534978	1207984	*Simphonia globulifera*	Cerillo	45
138	534971	1207980	*unknown*	unknown	13
139	534978	1207970	*Pterocarpus officinalis*	Sangrillo	90
140	534972	1207973	*Pterocarpus officinalis*	Sangrillo	70
141	534976	1207971	*Pterocarpus officinalis*	Sangrillo	62
142	534979	1207967	*Pterocarpus officinalis*	Sangrillo	14
143	534984	1207964	*Pterocarpus officinalis*	Sangrillo	64
144	534984	1207964	*unknown*	unknown	17
145	534988	1207959	*Pterocarpus officinalis*	Sangrillo	65
146	534992	1207966	*Pachira aquatica*	Popenjoche	39
147	534999	1207968	*Pterocarpus officinalis*	Sangrillo	40
148	534991	1207970	*Pterocarpus officinalis*	Sangrillo	66
149	534990	1207973	*Simphonia globulifera*	Cerillo	43
150	534991	1207971	*Pterocarpus officinalis*	Sangrillo	40
151	534990	1207984	*Simira maxonni*	Guaitil colorado	28
152	534989	1207981	*Simira maxonni*	Guaitil colorado	15
153	534989	1207981	*Simira maxonni*	Guaitil colorado	20
154	534991	1207990	*unknown*	unknown	42
155	534987	1207993	*Pachira aquatica*	Popenjoche	73
156	534987	1207993	*Pterocarpus officinalis*	Sangrillo	44
157	534985	1207999	*Pterocarpus officinalis*	Sangrillo	14
158	534988	1207993	*Pterocarpus officinalis*	Sangrillo	54
159	535002	1208000	*Grias cauliflora*	Tabacón	25
160	534999	1207989	*Pterocarpus officinalis*	Sangrillo	39
161	535003	1207992	*Pterocarpus officinalis*	Sangrillo	60
162	535003	1207982	*Simphonia globulifera*	Cerillo	23
163	535003	1207975	*Ceiba pentandra*	Ceiba	66
164	535010	1207967	*Pterocarpus officinalis*	Sangrillo	100
165	535010	1207964	*Pterocarpus officinalis*	Sangrillo	38
166	535015	1207967	*Pterocarpus officinalis*	Sangrillo	11
167	535015	1207967	*unknown*	unknown	21
168	535020	1207977	*Pterocarpus officinalis*	Sangrillo	24
169	535017	1207978	*Pterocarpus officinalis*	Sangrillo	29
170	535014	1207990	*Pterocarpus officinalis*	Sangrillo	60
171	535023	1207994	*Pterocarpus officinalis*	Sangrillo	23
172	535023	1207994	*Pterocarpus officinalis*	Sangrillo	20
173	535018	1208004	*Pterocarpus officinalis*	Sangrillo	16
174	535011	1208003	*unknown*	unknown	16
175	535006	1208004	*Pterocarpus officinalis*	Sangrillo	37
176	535007	1207997	*Pterocarpus officinalis*	Sangrillo	32
177	535017	1208013	*Pterocarpus officinalis*	Sangrillo	80
178	535019	1208009	*Ceiba pentandra*	Ceiba	62
179	535015	1208008	*Pterocarpus officinalis*	Sangrillo	19

180	535013	1208018	*Simphonia globulifera*	Cerillo	15
181	535019	1208025	*unknown*	unknown	38
182	535017	1208023	*Pterocarpus officinalis*	Sangrillo	15
183	535023	1208029	*Pterocarpus officinalis*	Sangrillo	15
184	535022	1208029	*unknown*	unknown	11
185	535029	1208030	*Pachira aquatica*	Popenjoche	41
186	535038	1208022	*unknown*	unknown	16
187	535034	1208018	*Pterocarpus officinalis*	Sangrillo	42
188	535033	1208018	*Pterocarpus officinalis*	Sangrillo	32
189	535033	1208018	*unknown*	unknown	10
190	535028	1208013	*Pterocarpus officinalis*	Sangrillo	39
191	535049	1208019	*unknown*	unknown	61
192	535049	1208019	*Pterocarpus officinalis*	Sangrillo	12
193	535056	1208019	*Pterocarpus officinalis*	Sangrillo	80
194	535029	1208010	*Pterocarpus officinalis*	Sangrillo	92
195	535046	1208005	*Lonchocarpus sp*	Chaperno	17
196	535035	1207994	*Pterocarpus officinalis*	Sangrillo	80
197	535036	1207994	*Pterocarpus officinalis*	Sangrillo	29

Source: Field Data

Annex 146

Report of the OAS Secretary General, Pursuant to Resolution CP/Res. 979 (1780/10), Presented to the twenty-sixth Meeting of Consultation of Ministers of Foreign Affairs of the OAS.

Available at:
http://www.scm.oas.org/doc_public/ENGLISH/HIST_10/RC00147E07.doc

7 December 2010

MEETING OF CONSULTATION OF MINISTERS OF FOREIGN AFFAIRS

TWENTY-SIXTH MEETING OF CONSULTATION

OEA/Ser.F/II.26

OF MINISTERS OF FOREIGN AFFAIRS

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December 7, 2010

8 December 2010

Washington, D.C.

Original: Spanish

REPORT OF THE OAS SECRETARY GENERAL

PURSUANT TO RESOLUTION CP/RES. 979 (1780/10)

Presented to the Twenty-Sixth Meeting of Consultation of Ministers of Foreign Affairs

December 7, 2010

REPORT OF THE OAS SECRETARY GENERAL

PURSUANT TO RESOLUTION CP/RES. 979 (1780/10)

Submitted to the 26th Meeting of Consultation of Ministers of Foreign Affairs

December 7, 2010

In compliance with resolution CP/RES. 979 (1780/10) of the Permanent Council of the Organization of American States (OAS), "Convocation of the Meeting of Consultation of Ministers of Foreign Affairs to Assess the Situation in the Border Area between Costa Rica and Nicaragua," adopted on November 18, 2010, I would like to inform this Meeting of Consultation of Ministers of Foreign Affairs regarding the implementation of the recommendations set out in Permanent Council resolution CP/RES. 978 (1777/10), "Situation in the Border Area between Costa Rica and Nicaragua," adopted on November 12 of this year.

The recommendations contained in resolution CP/RES. 978 (1777/10), adopted by the Permanent Council at the suggestion of the Secretary General, were the following:

> "1. To welcome and endorse the recommendations by the Secretary General entitled "Report by the Secretary General of the OAS on his visit to Costa Rica and Nicaragua" (CP/doc.4521/10) presented on November 9, 2010, with the objective that the Governments of Costa Rica and Nicaragua adopt the recommendations proposed in that report, namely:
>
> - *Hold the Eighth Meeting of the Binational Commission in order to address as a matter of urgency aspects of the bilateral agenda as soon as possible and no later than the date originally agreed, with the assistance of the OAS.*
> - *Immediately resume the talks on aspects concerning the demarcation of the boundary line done to date, in accordance with the treaties and decisions in force.*
> - *In order to create a favorable climate for dialogue between the two nations, avoid the presence of military or security forces in the area, where their existence might rouse tension.*
> - *Instruct the appropriate authorities to review and strengthen cooperation mechanisms between the two nations in order to prevent, control, and confront drug trafficking, organized crime, and arms trafficking in the border area.*
>
> 2. To invite the parties to initiate simultaneously and without delay the processes referred to in the foregoing paragraph.

3. To request the Secretary General to continue exercising his good offices to facilitate the dialogue between the parties and to keep the Permanent Council informed in this regard."

The current status of each of the specific recommendations contained in operative paragraph 1 of resolution CP/RES. 978 is as follows:

1. Regarding the Eighth Meeting of the Binational Commission between Costa Rica and Nicaragua

At the start of the differendum, the Binational Commission was scheduled to hold its technical phase on November 26 and its high-level phase on November 27.

In accordance with that schedule, the Foreign Ministry of Costa Rica sent a note to the OAS General Secretariat on November 22 to request the presence of the Organization at that meeting "in the terms set out by the Permanent Council in the aforesaid resolution." At the same time, the Foreign Ministry of Costa Rica deemed it wise to point out in its note that that meeting would be held "following the withdrawal of the Nicaraguan armed forces and civilian personnel currently occupying Costa Rican territory."

On November 24, the Foreign Ministry of Nicaragua sent a note to the Foreign Ministry of Costa Rica to "reaffirm our Government's unshakeable willingness and commitment to hold the meetings planned in the context of the Binational Commission, according to the Agenda to be prepared by both our countries and in accordance with the principle of unconditionality that characterizes meetings of this kind."

That same day, the Foreign Ministry of Costa Rica sent a note to the Foreign Ministry of Nicaragua stating that "Costa Rica is fully willing for this meeting to be held as scheduled, once Nicaragua has withdrawn the troops it has deployed in Costa Rican territory." In addition, that same day, the Foreign Ministry sent a note to the OAS Secretary General, indicating that the "holding of the activities under the aegis of the Eighth Meeting of the Binational Commission between Costa Rica and Nicaragua scheduled for Friday, November 26, and Saturday, November 27, 2010, shall be subject to the report to be presented by the OAS technical team for the on-site verification of compliance with the agreements adopted by the Permanent Council of the Organization in resolution CP/RES. 978 of November 12."

On November 26, statements published in newspapers quoted official Nicaraguan sources as saying that no authority from that country would be attending the bilateral meeting scheduled for that day, as one of the parties still had conditions for dialogue.

In the interests of brevity, I shall omit detailing the successive exchanges of notes and statements from high-level authorities of the two countries dealing with the topic. The key point is that the Eighth Meeting of the Binational Commission planned for November 26 and 27 did not take place. A delegation from the General Secretariat, comprising Ambassador Dante Caputo and specialist Antonio Delgado, was present in Costa Rica on the day set for the meeting in order to verify that fact.

2. Regarding the talks on the demarcation of the boundary line

Since the meeting of the Binational Commission scheduled for November 26 and 27 did not take place, and since there has been no contact whatsoever between the two countries on this point, it is obvious that there has been no progress with the demarcation talks.

3. Regarding the presence of military or security forces in the area, where that presence might rouse tension

On Friday, November 26, Ambassador Dante Caputo, accompanied by specialist Antonio Delgado, flew over the area to report back to the Secretary General on compliance with this point.

The following are the key elements noted by Ambassador Caputo from his observation:

> *"In the area of the dispute, observations were conducted under good conditions of visibility and in greater detail than on the previous occasion.[1] My impression is that the area where trees have been felled is greater than during the previous observation, tents can be seen in the location, the Nicaraguan flag, and the entrance of the river course in the Río San Juan can be clearly distinguished – better than during our previous flyover. I photographed this entire area and these comments can be checked against the photos. I saw no members of the armed forces on the ground. That does not necessarily mean that there were none. In contrast, the military presence on board the dredger was obvious. It can be clearly seen in one of the photographs."*

The photographs taken by Ambassador Caputo are attached to this report and were delivered with the following note:

> *"You can see… the San Juan, the river course that has been opened, the felled trees, the cleared area with tents and clothing out to dry, although no soldiers are to be seen, the dredger with three or four armed men in uniforms."*

In conclusion, everything seems to indicate a Nicaraguan presence still in the area, with certain evidence of a military presence. In addition, the felling of trees and the opening of a river channel in the area can be seen.

4. Regarding the review and strengthening of cooperation mechanisms targeting drug trafficking

---

[1]. **Ambassador Caputo accompanied the Secretary General in flying over the area on two earlier occasions, from Nicaraguan territory and from Costa Rican territory, on November 7 and 8, 2010, respectively.**

There has been no activity between the two parties on this topic.

Other issues

In addition to all the above, it must be noted that on November 18, the Republic of Costa Rica appeared before the International Court of Justice of Justice to institute proceedings against Nicaragua "in connection with an alleged incursion into, occupation of, and use by Nicaragua's Army of Costa Rican territory," in which it accused that country of violating its obligations toward Costa Rica set out in numerous international treaties and conventions. At the same time, Costa Rica asked the International Court of Justice to issue provisional precautionary measures based on the need to preserve its right to sovereignty, territorial integrity, and noninterference in its rights, and on the conservation of its environmentally protected areas.

On November 30, Nicaragua replied to a later Costa Rica note by stating that its country holds that "the issues raised by the Government of Costa Rica... are subject to the jurisdiction of the International Court of Justice, and so it does not believe it appropriate to offer comments on them outside that venue." The International Court of Justice has set January 11 to 13, 2011, to hear the parties regarding the request for provisional measures lodged by Costa Rica on November 18, 2010.

Finally, I must make reference to the decision of both countries, at different times in this dispute, to invoke the International Convention on Wetlands – known as the Ramsar Convention – in defending their rights in this matter.

APPENDICES


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Annex 147

Ramsar Secretariat, Ramsar Advisory Mission Report N° 69: North-eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica.

17 December 2010

Ramsar

Convention on Wetlands

(Ramsar, Iran, 1971)

Report

Ramsar Advisory Mission (RAM) No. 69

North-eastern Caribbean Wetland of International Importance (Humedal Caribe Noreste), Costa Rica

17 December 2010

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Executive Summary

The Caribe Noreste Ramsar Site, which was designated as a Wetland of International Importance on 20 March 1996, extends to 75,310 ha and is situated in the provinces of Limón and Heredia. This wetland includes lakes, flooded forests, rivers and estuarine lagoons. It is an area of great importance as a resting place for Neotropical migratory birds. It is also home to several endemic species of salamanders. Land use is principally given over to the development of agricultural and livestock rearing activities, tourism and fishing (Ramsar Information Sheet, 1996).

The Government of Costa Rica informed the Ramsar Secretariat on 15 and 22 November 2010 of changes in the ecological character of the Humedal Caribe Noreste (HCN) Ramsar Site in accordance with Article 3.2 of the Convention. It requested a Ramsar Advisory Mission to be carried out urgently pursuant to Recommendation 4.7 in order to assess the changes in the ecological character of the site due to a dredging operation on the river-bed of the San Juan river in the western sector of the Laguna los Portillos.

In response to Costa Rica's request, and under the auspices of the Secretariat, the Ramsar Advisory Mission took place from 27 November to 1 December 2010. Its main aim was to assess the changes in the ecological character of the Humedal Caribe Noreste Ramsar Site in order to implement recommendations to maintain the ecological characteristics of this wetland, but it was clearly specified that the Mission would have a technical emphasis and that the Ramsar Secretariat would not be involved in any political situation between Contracting Parties.

It is important to stress that the Mission's aim, and therefore that of the resulting report, is not to pass judgement on actions being taken in the area of the Humedal Caribe Noreste Ramsar Site but, in line with the objectives of the Convention, to carry out an impartial and objective technical analysis of the situation without alluding to any political considerations, following which a series of conclusions and recommendations would be submitted to government departments and decision-makers.

After the visit to Costa Rica, consultations and reviewing technical information, the Mission submitted the following conclusions and recommendations:

Conclusions

- According to the analysis of the technical information received from the Government of Costa Rica, there are changes in the ecological characteristics of the Humedal Caribe Noreste in the area of direct influence involving around **225** ha (**2.25** km²) or **0.3**% of the total wetland area (**75,310** hectares, or **753** km²).

- Aquatic system components, i.e. water quality, aquatic flora and fauna, and resident and migratory birds, would be the most affected.

- Although the analysis carried out is confined to the HCN, it is clear from the information analysed that the Laguna los Portillos, located in the Refugio de Vida Silvestre Río San Juan Ramsar Wetland in Nicaragua, would be the most affected, with the hydraulic connection with the San Juan river.

- If dredging operations continue in the San Juan River, the dredged sediments should not be deposited over the HCN wetland area.

- Should the changes continue in magnitude and extent on the San Juan river (as per the current situation), it is likely that the medium- and long-term scenarios described will become a reality.

Recommendations

To support the Government of Costa Rica in maintaining the ecological characteristics of this wetland, the RAM recommends:

- Due to its geographical location and dynamics closely linked to the Refugio de Vida Silvestre Corredor Fronterizo and to the Refugio de Vida Silvestre Río San Juan Ramsar Site, the preservation of the Humedal Caribe Noreste calls for substantial cooperation and collaboration between the two bordering countries of both Ramsar sites pursuant to the Convention's guidelines for international cooperation.

- It is important to carry out rigorous environmental impact assessments for any project or activity that might affect the hydrology and hydrodynamics of the Caribe Noreste Ramsar Site and the Refugio de Vida Silvestre Río San Juan Ramsar Site.

- It is recommended that a system should be set up to monitor the ecological characteristics of Ramsar wetland sites and protected reserves on either side of the two countries, given the strong hydraulic connection and hydrodynamic balance existing on both sides.

- Sharing information on the physical, chemical and biological characteristics of the San Juan river is important, as well as on the wetlands of the Caribe Noreste and Refugio de Vida Silvestre Río San Juan Ramsar Sites.

- It is crucial to maintain the river discharge and patterns of the San Juan river upstream of the HCN in order to preserve it as a healthy and sustainable wetland in the long term.

- Deforestation of the HCN should be avoided so as to prevent the erosion and reduction of aquifer recharge.

- To maintain the current ecological conditions of the wetland, the surface run-off patterns should be restored before the sandbank of the Laguna los Portillos is breached.

- Taking into account the current state of the wetland and in the light of scenarios put forward, it is recommended that the Caribe Noreste Ramsar Site should be included on the Montreux Record.

Ramsar Advisory Mission (RAM) No. 69

Caribe Noreste Ramsar Site, Costa Rica

27 November to 1 December 2010

Ramsar Convention Secretariat

1. General introduction

The Convention on Wetlands, signed in Ramsar, Iran, on 2 February 1971, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. As at 13 July 2010, there were 160 Contracting Parties to the Convention and 1,907 Wetlands of International Importance, with a total surface area of 186,598,826 hectares.

The Convention is based on three pillars: the wise use of all wetland resources in each country, the designation of wetlands of international importance and their management, and international cooperation.

1.1 Wetlands of International Importance and the Convention's provisions

The Contracting Parties to the Convention on Wetlands are obliged, under Article 2, paragraph 4, to designate at least one site to be registered on the List of Wetlands of International Importance when signing the Convention or depositing their ratification or accession instrument, in conformity with the provisions of Article 9. Under Article 1, paragraph 1," wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres" and "they may incorporate riparian and coastal zones adjacent to the wetlands, and islands or bodies of marine water deeper than six metres at low tide lying within the wetlands" (Article 2, paragraph 1).

The Ramsar List of Wetlands of International Importance, pursuant to Article 2 of the treaty text, is the cornerstone of the Ramsar Convention. Its main objective is to create and maintain an international network of wetlands that are important for the conservation of global biodiversity and sustaining human life by preserving the components, processes and benefits/services of its ecosystems. A further objective is to promote cooperation between the Contracting Parties and local, directly-interested parties on the selection, designation and management of Ramsar Sites.

The designation of sites for inclusion in the List of Wetlands of International Importance should be "on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology" (Article 2, paragraph 2). Under Article 3, paragraph 1, of the Convention, the Contracting Parties are obliged to "formulate and implement their planning so as to promote the conservation of the wetlands included in the List, and as far as possible the wise use of wetlands in their territory".

Article 3, paragraph 2, of the Convention stipulates that each Contracting Party should take any necessary measures to ensure that they are informed at the earliest possible time of any changes in the ecological conditions of the wetlands in its territory and included in the List, and if they have occurred or are likely to occur as a result of technological developments, pollution or any other human interference. Information on such changes should be forwarded without delay to the Secretariat in accordance with *Article 8*.

Accordingly, the Contracting Parties, by designating Ramsar sites, undertake to manage those sites in such a way as to ensure that the ecological characteristics of each one are preserved and thus maintain the essential ecological and hydrological functions that ultimately result in their "products, functions and attributes".

Designating Ramsar sites, however, is not the last but only the first step in the process to achieve effective wetland management and conservation. The development and implementation of planning instruments such as comprehensive and detailed management plans, the preparation of land management plans with clear definitions on possible land use, strategic environmental planning and environmental impact assessments, together with political will, are essential requirements to guarantee the maintenance of the ecological characteristics of Ramsar sites.

"Ecological characteristics" are understood to be a combination of the components (biological, chemical, physical), processes and services that characterize the wetland at a given point in time. When these characteristics are changed, the Contracting Parties may include the site in the so-called "Montreux Record" as a way of drawing attention to existing problems and to the intention to seek adequate solutions to them.

The Montreux Record is a register of wetland sites on the List of Wetlands of International Importance where changes in ecological character are occurring, have occurred, or are likely to occur as a result of technological developments, pollution or other human interference. The Record forms part of the Ramsar List.

This Record was established by Recommendation 4.8 of the Conference of the Contracting Parties (1990). Resolution 5.4 of the Conference (1993) determined that the Montreux Record should be employed to identify sites for priority national and international attention with a view to the conservation of their ecological characteristics. Sites can only be registered on or removed from the Record upon the request of the Contracting Parties where they are located.

To date, seven sites in the Americas region are included on the Record (Argentina: Laguna de Llancanelo, 02/07/01, Costa Rica: Palo Verde, Guanacaste: 16/06/93, Guatemala: Laguna del Tigre, El Petén: 16/06/93, United States of America: Everglades, Florida, 16/06/93, and Uruguay: Bañados del Este y Franja Costera, Rocha, 04/07/90, Bahía de Bluefields, Nicaragua, 15/01/07).

1.2 The concepts of change in ecological characteristics, wise use and ecosystem services

Change in ecological characteristics is defined according to the Convention as a change produced in any of the components (biological, chemical, physical), ecological processes or services of the wetland induced by human action.

For its part, the concept of wise use is one of the three pillars of the Convention and refers to the maintenance of the ecological character through the implementation of ecosystem approaches within the context of sustainable development.

Under the Ramsar Convention, the Contracting Parties, through Resolution IX.1 Annex A.j, adopted the relevant aspects of wetland ecosystem services from the Millennium Ecosystem Assessment. In this context, the benefits that people obtain from ecosystems are defined in Table 1. These include provisioning services such as food and water; regulatory services such as control of floods, drought, land degradation and disease; supporting services such as soil formation and nutrient cycling; cultural services such as recreational, spiritual or religious; and other non-material benefits.

Table 1. Wetland ecosystem services, as defined in the Millennium Ecosystem Assessment (2005).

Provisioning services	**Regulatory services**	**Cultural services**
Products obtained from ecosystems • Food • Fresh water • Fuel • Vegetable fibre • Biochemicals • Genetic materials	Benefits obtained from the regulatory processes of ecosystems • Climate regulation • Disease control • Water regulation • Water purification • Pollination	Non-material benefits obtained from ecosystems • spiritual and religious • recreational and tourism • aesthetic • inspirational • educational • sense of identity • cultural heritage
Supporting services Services required for the production of all other ecosystem services Soil formation Nutrient cycling Primary production		

1.3 Ramsar Advisory Missions (RAM)

In paragraph 18 of Resolution X.13 (2008), the Contracting Parties reaffirmed the commitment “to implement fully the terms of Article 3.2 on reporting change and to maintain or restore the ecological character of their Ramsar sites, including employing all appropriate mechanisms to address and resolve as soon as possible the matters for which a site may have been the subject of an Article 3.2 report; and, once those matters have been resolved, to submit a further report, so that both positive influences at sites and changes in ecological character may be fully reflected in the reporting to meetings of the Conference of the Parties in order to establish a clear picture of the status and trends of the Ramsar site network."

Under the Convention, special attention is given to assisting member States in the management and conservation of listed sites whose ecological character is threatened. This is carried out through the Ramsar Advisory Mission (RAM), a technical assistance mechanism formally adopted by Recommendation 4.7 of the 1990 Conference of the Parties. The main objective of this mechanism is to provide assistance to developed and developing countries alike in solving the problems or threats that make inclusion in the Montreux Record necessary.

After receiving a request from a Contracting Party, the Secretariat agrees to organize the RAM with the relevant authorities and decides on the type of expertise that will be required in the Mission's team. The Mission's draft report, which sets forth conclusions and recommendations, is sent to the relevant authorities who requested the RAM for comments, and the final revised version becomes a public document, providing a basis for adopting conservation measures for the site.

1.4 International cooperation under the Ramsar Convention

The Ramsar Convention has a central role to play in international cooperation, representing the single most important framework for intergovernmental cooperation on wetland issues. Article 5 of the Convention on Wetlands stipulates that: "The Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna."

To assist Contracting Parties in fulfilling this obligation in accordance with the Convention, in 1999 the Conference of the Parties adopted the Guidelines for international cooperation under the Ramsar Convention (Resolution VII.19), which deal with the following areas:

- Managing shared wetlands and river basins
- Managing shared wetland-dependent species
- Ramsar working in partnership with international/regional environment

conventions and agencies

- Sharing of expertise and information
- International assistance to support the conservation and wise use of wetlands
- Sustainable harvesting and international trade in wetland-derived plant and animal products
- Regulation of foreign investment to ensure wetland conservation and wise use.

In adopting the Guidelines, the Conference called upon Contracting Parties to give special attention to identifying wetlands, river basins and shared wetland-dependent species and to cooperate with other Parties in their management; to harmonize the implementation of the Ramsar Convention with that of other treaties; to increase the number of site twinning arrangements; and to raise the level and effectiveness of international development assistance programmes directed at the long-term conservation and sustainable use of wetlands.

Conservation of transboundary wetlands

Individual action by States may be insufficient for the conservation and management of wetlands because many wetlands and watercourses cross national borders; many wetland species are migratory; coherent management of wetlands often requires collaboration and exchange of experiences between countries; and development assistance is often required for wetland conservation actions in developing countries. There are recent examples of international cooperation wetlands and water systems.

It is clear that Contracting Parties are increasingly designating their new and existing Ramsar sites as transboundary Ramsar sites, meaning that an ecologically cohesive wetland extends across national borders and the Ramsar site authorities on both or all sides of the border have formally agreed to collaborate on its management, and have notified the Secretariat of this decision.

Likewise, with respect to transboundary species conservation, many species of migratory birds follow migratory flyways or routes along which are situated wetlands that they use as resting and feeding areas. To achieve the effective conservation of such species requires cooperation between States sharing wetland systems or situated along a flyway. The Secretariat works to facilitate such cooperation.

1.5 Implementation of the Ramsar Convention in Costa Rica

Costa Rica acceded to the Convention on 27 April 1992, designating the Palo Verde and Caño Negro wetlands for inclusion as Wetlands of International Importance. Costa Rica has 12 wetlands currently on the List of Wetlands of International Importance, extending to 569,742 ha. Their designation and management is administered through the Ministry of Environment and Energy's National System of Conservation Areas (SINAC).

SINAC acts as the Convention's Administrative Authority and implementing body in Costa Rica.

With regard to the implementation of actions in wetlands, Costa Rica has received support from Ramsar through the Wetlands for the Future Fund, which has granted resources for 19 projects of approximately US$210,751 for training, baseline and awareness-raising activities.

Similarly, it has received financing for two projects through the Convention's Small Grants Fund of approximately CHF120,000 for the land use regulations of the Refugio Nacional de Vida Silvestre Tamarindo and the prevention and control of forest fires in the Refugio de Vida Silvestre Caño Negro.

Furthermore, it should be underlined that Costa Rica is part of the regional initiative for the conservation and wise use of wetlands in the High Andes and the Convention's mangrove and coral reef initiative.

2. The Mission's Work Programme

Aim of the Mission

Article 3, paragraph 2, of the Convention stipulates that each Contracting Party should take any necessary measures to ensure that they are informed at the earliest possible time of any changes in the ecological conditions of the wetlands in its territory and included in the List, and if they have occurred or are likely to occur as a result of technological developments, pollution or any other human interference. Information on such changes should be forwarded without delay to the Secretariat in accordance with *Article 8*.

To that end, the Government of Costa Rica informed the Secretariat on 15 and 22 November 2010 of changes in the ecological character of the Caribe Noreste Ramsar Site and requested a Ramsar Advisory Mission to be carried out urgently pursuant to Recommendation 4.7 in order to assess the changes in the ecological character of the site due to the existence of a dredging operation on the river-bed of the San Juan river in the western sector of the Laguna los Portillos.

In response to Costa Rica's request, and under the auspices of the Secretariat, the Ramsar Advisory Mission made its main aim to assess the changes in the ecological character of the Caribe Noreste Ramsar Site in order to implement recommendations that would help the Government of Costa Rica to maintain the ecological characteristics of this wetland. It was also made specifically clear that the Mission would have a technical emphasis and that the Secretariat would not be involved in any political situation between Contracting Parties.

It is important to stress that the Mission's aim, and therefore that of the resulting report, is not to pass judgement on actions being taken in the area of the Caribe Noreste Ramsar Site but, in line with the objectives of the Convention, to carry out an impartial and objective technical analysis of the situation without alluding to any political considerations, following which a series of conclusions and recommendations would be submitted to government departments and decision-makers.

Programme of activities

The Mission was coordinated by the Ramsar Convention Secretariat through the Senior Advisor for the Americas, an expert in hydrogeology, hydrology and geology and another in aquatic ecology, limnology and aquatic resources. The Mission was carried out from 27 November to 1 December 2010, with the support of management and professional staff of the Costa Rican Ministry of Foreign Affairs, Ministry of Environment and Energy and the National System of Conservation Areas.

RAM members reviewed and analysed the supplementary information provided by the Government of Costa Rica and various participating bodies. During the visit, other relevant reports and documents were also consulted and these are listed in the bibliography. Technical meetings with various interested parties were also held, including with local and regional authorities. The Mission's programme of activities can be found in annex 1.

The Mission intended to conduct an overflight in the Humedal Caribe Noreste area but, due to weather conditions and safety reasons, it was not possible to do so.

3. Baseline information on the Humedal Caribe Noreste Ramsar Site

This section describes the baseline information on the Humedal Caribe Noreste (HCN) with respect to its hydrology, ecology, geology, soil, fluvial dynamics and ecosystem services. This baseline information is written objectively, based on existing information, with current data from technical documents, photographs and satellite images.

Given the wetland's interaction with its surroundings, and the water sources that have created the wetland, the descriptions have been presented in different spatial and time scales. There are three different spatial scales: regional, intermediate and local (wetland). The regional scale covers the entire San Juan river basin. The time scale was defined according to the water cycle dynamics of the San Juan River.

The analysis of the changes in the HCN site considered different spatial and time scales according to the environmental features of the area and the water cycle dynamics.

Caribe Noreste Ramsar Site

It was designated as a Wetland of International Importance on 20 March 1996, extends to 75,310 ha and is situated in the provinces of

Limón and Heredia. This wetland includes lakes, flooded forests, rivers and estuarine lagoons. It is an area of great importance as a resting place for Neotropical migratory birds. It is also home to several endemic species of salamanders. Land use is principally given over to the development of agricultural and livestock rearing activities, tourism and fishing (Ramsar Information Sheet, 1996).

The site was included in the List of Wetlands of International Importance based on the following criteria:

1. As a unique or representative wetland, being a natural wetland characteristic of the Costa Rican Caribbean coastal zone.

2. It supports species and subspecies of plants and animals that are vulnerable or under threat of extinction. Furthermore, it is highly valued as a stronghold of the region's genetic and ecological diversity.

3. It is an obligatory stopover for migratory birds from North America, providing shelter for over one million birds that come to rest and feed.

Ecological features

The Humedal Caribe Noreste is composed of a mosaic of water bodies and courses fed by the San Juan river delta, encircled by a sandbank that separates the wetlands from the Caribbean Sea, giving rise to lagoons, grass marshes and/or wooded swamps. The main water supply comes from the San Juan River, with a groundwater supply that maintains the superficial aquifer level. The low tides that partially control the estuary level during periods of river drought (Procuenca de San Juan, 2004), potentially generate a supply of salt water to the bodies of water closest to the sandbank (Winemiller and Leslie, 1992).

The spatial heterogeneity resulting from salinity gradients (0 <salinity<35 g/L) and residence times of aquatic ecosystems (rivers and lakes) is reflected in a great wealth of aquatic and terrestrial flora and fauna found in the Humedal Caribe Noreste (HCN; Management Plan for the Refugio Nacional de Vida Silvestre, 2010; Management Plan for the Parque Nacional Tortuguero, 2004; Chuprine and Hernandéz, 2005).

With regard to aquatic life, the San Juan River is located in the Íctica province of San Juan, where eight families, 25 genera and 54 species of freshwater fish, and at least 84 species of marine fish, are registered (Thorson, 1976). Studies by Winemiller and Leslie (1992) and Bussing (2002) describe communities of freshwater fish in Costa Rica, and found that there is a greater diversity of fish in the lagoons (80 species) than near the seashore (42 species); the reason being that large structural heterogeneities exist in the lagoons in the form of a variety of aquatic vegetation, submerged trees, silt, debris, etc. These are not present in the coastal zone, which is characterized by a regular shoreline and a sandy bottom.

Aquatic ecosystems provide a stopover site for species of migratory fish such as the Atlantic tarpon (*Megalops atlanticus*), Fat snook (*Centropomus parallelus*) and Bull shark (*Carcharhinus leucas*), and a breeding site for 26 species of fish, including the Burro grunt (*Pomadasys spp.*). They shelter one of the two populations of Costa Rican Tropical gar (*Atractosteus tropicus*) and the only population of manatees in Costa Rica. In addition, 134 species of mainly aquatic migratory birds are found and the aquatic ecosystems also support the main patches of yolillo of the Costa Rican Caribbean. They provide a source of fishing products for the inhabitants of the Humedal Caribe Noreste. The beach areas provide food and a breeding site for the Green sea turtle (*Chelonia mydas*) and the Leatherback turtle (*Dermochelys coriacea*). It is especially pertinent to highlight the presence of the West Indian manatee (*Trichechus manatus*), which is a species that has been declared under threat of extinction.

Aquatic ecosystems provide two sources of food in terms of carbon flow: i) autochthonous, derived from the primary production of aquatic vegetation present in bodies of water; and allochthonous, from the incorporation of organic matter from terrestrial vegetation. The latter establishes the functional link existing between terrestrial vegetation and the structure and function of aquatic ecosystems.

The HCN is one of the areas of the Costa Rican Caribbean region with higher levels of biological diversity of terrestrial flora and fauna, a diversity that can be found in several kinds of habitat such as:

- Coastal or beach vegetation, where coconut trees (*Cocos nucifera*) are very common.
- Tall hill forests.
- Wooded swamps or flooded forests, with species of trees such as the Captive wood (*Prioria copaifera*), Kapok tree (*Ceiba pentandra*), Gavilan (*Pentaclethra macroloba*), Andiroba (*Carapa guianensis*) and Guiana chestnut (*Pachira aquatica*).
- Yolillales*,* woodlands formed and dominated by the yolillo palm *(Raphia taedigera*).
- Grass marshes, where the Paspalum grass (*Paspalum sp.*) is very common.
- Floating herbaceous plant communities, where the Common water hyacinth (*Eichhornia crassipes*) is very common, which even at times hampers navigation.

Flora includes 779 species (Onca Natural, 2006), with some of the most abundant trees being the Gavilan (*Pentaclethra macroloba*), Golden Fruit (*Virola koschnyi*), Andiroba (*Carapa guianensis*), Captive wood (*Prioria copaifera*) and Guiana chestnut (*Pachira aquatica*). Species present include 36 plants that are endemic to Costa Rica (*http://atta.inbio.ac.cr*, 2005), some of which are listed in Table 2. In the studies conducted to date, no plant species listed in the categories of endangered or under threat of extinction have been found and only one with reduced populations, as in the case of the Guaco (*Mikania guaco*) of the *Asteraceae* family.

A third of the country's species of fauna declared under threat of extinction are present, such as Baird's tapir (*Tapirus bairdii*); felines, including the Jaguar (*Panthera onca*), Ocelot (*Leopardus pardalis*), Jaguarondi (*Herpailurus yaguarrondi*) and Cougar (*Puma concolor*);

monkeys, including the Howler monkey (*Alouatta palliate*), Capuchin monkey (*Cebus capucinus*) and Spider monkey (*Ateles geoffroyi*); and the Three-toed sloth (*Bradypus variegates*), the Harpy eagle, the Paca (*Cuniculus paca*) and the Great Green Macaw (*Ara ambiguus*).

Birds currently found throughout the area include the Osprey (*Pandion haliaetus*), Keel-billed toucan (*Ramphastos sulfuratus*), Neotropic cormorant (*Phalacrocorax brasilianus*), Little blue heron (*Egretta caerulea*), Tricoloured heron (*Egretta tricolor*), White hawk (*Leucopternis albicollis*), Great Tinamou (*Tinamus major*), Great Curassow (*Crax rubra*) and the Red-lored Amazon (*Amazona autumnalis*), which are species that are generally common and widely distributed.

Table 2. Species of endemic flora present in the HCN

Family	Species	Family	Species
Acanthaceae	*Aphelandra storkii*	Fabaceae/Caes.	*Macroiobium herrerae*
Amaranthaceae	*Alternanthera costaricensis*	Fabaceae/Mim.	*Zygia confusa*
Annonaceae	*Guatteria aeruginosa*	Gesneriaceae	*Besleria columneoides*
	Unonopsis stevensii		*Drymonia submarginalis*
Araceae	*Anthurium Austin-smithii*	Marantaceae	*Calathea hammelii*
	Anthurium subsignatum	Marcgraviaceae	*Marcgravia pittieri*
	Dieffenbachia concinna	Melastomataceae	*Clidemia pubescens*
	Monstera costaricensis	Myrtaceae	*Eugenia siggersii*
	Philodendron aromaticum	Orchidaceae	*Scaphyglottis limonensis*
Boraginaceae	*Bourreria costaricensis*	Passifloraceae	*Passiflora lancearia*
Bromeliaceae	*Aechimea mariae-reginae*	Piperaceae	*Peperomia vueltasana*
Cactaceae	*Hylocereus stenopterus*		*Piper pseudobumbratum*
Chrysobalanaceae	*Licania belloi*	Rubiaceae	*Coussarea talamancana*
	Licania stevensii		*Manettia longipedicellata*
Connaraceae	*Connarus costaricensis*		*Psychotria laselvensis*
	Rourea suerrensis		*Randia grayumii*
Cyperaceae	*Cyperus costaricensis*		*Rudgea monofructus*
Dichapetalaceae	*Dichapetalum moralesii*	Solanaceae	*Solanum mirabile*

Around 400 species of herpetofauna, 174 species of amphibians and 222 species of reptiles are recognized throughout Costa Rica (Savage, 2002). Specifically in the HCN, there are probably 54 species of amphibians and 110 species of reptiles. Many of the expected species for the area are subject to some form of conservation status (**Table 3**). However, their status and various other factors, such as maintaining a certain species in its habitat, determine possible management choices.

In Costa Rica, there are approximately 1,570 species of vertebrates, up to 20% of which are endemic, which is why the conservation of these and many other species calls for the protection of the ecosystems that ensure the conditions for their survival (Garcia, 2002). It is important to conserve forests, since conserving plant species considered to be key resources for fauna enables animals to survive. Moreover, forest fauna play a very important role in tropical forest dynamics. For example, animals that feed on nectar, fruit and seeds contribute to the processes of pollination, seed dispersal and regeneration of commercial species (Fundación Simón I. Patiño, 2004).

Available data on the wealth and abundance of aquatic and terrestrial flora and fauna in the Humedal Caribe Noreste clearly highlight how valuable the area is in terms of its biodiversity, which is closely linked to the characteristics of its aquatic and terrestrial ecosystems. The HCN is an area of importance for the conservation of the country's unique species.

Table 3. Potential species in HCN with some level of threat, according to UICN, MINAE and CITES

Species	Status according to IUCN	Status according to MINAE	CITES
Amphibians			
Caecilians			
Gymnopis multiplicata		Reduced population	
Salamanders			
Bolitoglossa colonnea		Reduced population	
Oedipina cyclocauda		Reduced population	
Oedipina gracilis	Endangered		
Frogs and toads			
Bufo melanochlorus		Reduced population	
Dendrobates auratus		Reduced population	Appendix II
Dendrobates pumillo		Reduced population	Appendix II
Phyllobates lugubris		Reduced population	Appendix II
Agalychnis calcarifer		Reduced population	
Agalychnis saltator	Near Threatened	Reduced population	
Smilisca puma	Vulnerable		
Eleutherodactylus mimus		Reduced population	
Eleutherodactylus noblei		Reduced population	
Eleutherodactylus ranoides	Critically Endangered		
Eleutherodactylus altae	Vulnerable	Reduced population	
Rana warszewitschii	Near Threatened		
Reptiles			
Lizards			
Iguana iguana			Appendix II
Thecadactylus rapicauda		Reduced population	
Dactyloa frenata		Reduced population	
Norops lemurinus		Reduced population	
Norops carpenteri		Reduced population	
Norops pentaprion		Reduced population	
Polychrus gutturosus		Reduced population	
Snakes			
Boa constrictor		Under threat of	Appendix I

		extinction	
Corallus annulatus		Reduced population	
Ungaliophis panamensis		Reduced population	
Clelia clelia		Reduced population	Appendix II
Micrurus nigrocinctus			Appendix III
Turtles			
Kinosternon angustipons	Vulnerable	Reduced population	
Chelydra serpentina		Reduced population	
Dermochelys coriacea	Critically Endangered	Under threat of extinction	Appendix I
Caretta caretta	Endangered	Under threat of extinction	Appendix I
Chelonia mydas	Endangered	Under threat of extinction	Appendix I
Eretmochelys imbricata	Critically Endangered	Under threat of extinction	Appendix I
Chrysemys ornata	Near Threatened		
Rhinoclemmys annulata	Near Threatened		
Rhinoclemmys funerea	Near Threatened		
Crocodiles			
Caiman crocodilos		Reduced population	Appendix II
Crocodylus acutus	Vulnerable	Under threat of extinction	Appendix I

Ecosytem services

As mentioned in section 1.2, according to the Millennium Ecosystem proposal, environmental/ecosystem services are the benefits that people obtain from ecosystems. These include the provisioning, regulatory and cultural services that directly affect people, in addition to the services required to sustain ecological processes (support).

In this connection, the Humedal Caribe Noreste (HCN) offers a series of basic ecosystem services to maintain the structure and function of the territory, including the following:

<u>Flood control</u>: The HCN has a surface area of 75,310 ha, composed of a mosaic of water bodies and courses, which accumulate and

redistribute the volume of water from the San Juan and Colorado rivers during flood periods. Even when there are no human settlements in the area, this capacity to absorb floods permits normal development of ecological processes and ecotourism activities.

Groundwater recharge: At the mouth of the San Juan and Colorado rivers in the Caribbean Sea, there is a climatic peculiarity that produces around 7,000 mm of annual rainfall. This allows the groundwater recharge that occurs in the HCN to be established, which constitutes an important backup water supply for the ecosystems found on the Caribbean coast of Costa Rica during periods of drought.

Retention of sediments and nutrients: It is estimated that there is a mass output of 190-763 Ton/day from the Lake Nicaragua outlet, which is partially retained in the network of water bodies and courses in the HCN. 80% of the bottom sediments are stored downstream of the river basin and along the coastal strips, represented by beaches, which restrict the formation of an estuary due to incoming waves and/or sea currents. As for nutrients, Lake Nicaragua receives a supply of 907 Ton/year of nitrogen and 4,984 Ton/year of phosphorous, which means that the San Juan River, from its source, may have a euthrophic to hypereuthrophic condition (Procuenca de San Juan, 2004). One of the most important functions of the wetlands is the recycling of nutrients deposited from the hydrographic basin, a process that occurs in the HCN transferring such materials to the food web.

Water purification: The HCN acquires polluted water through agricultural activity, mainly due to the cultivation of the banana plant and human settlements (faecal coliforms in the lagoons of Tortuguero of over 2,400 coliforms/100 ml). This background information was provided in the technical data sheet compiled by PACTo-MINAE for the Ramsar Convention (1996). Such pollutant loads are partly offset by the biogeochemical processes that occur inside the wetland, mainly through the merger between aquatic plants and bacteria.

Biodiversity reservoirs: Available data on the wealth and abundance of aquatic and terrestrial flora and fauna in the Humedal Caribe Noreste clearly highlight how valuable the area is in terms of its biodiversity, which is closely linked to the characteristics of its aquatic and terrestrial ecosystems. The HCN is an area of importance for the conservation of the country's unique species.

Wetland products: In some HCN lagoons, subsistence fishing and recreational fishing (Laguna Tortuguero) take place. Subsistence fishing is with a hook and line, but in some sectors illegal fishing with gillnets has been observed. Poaching of animals for direct consumption or subsequent sale is evident, the most affected species being the paca (*Agouti paca*), peccary (*Tayassu pecari*), Baird's tapir (*Tapirus bairdii*), white-tailed deer (*Odocoileus virginianus*) and nine-banded armadillo (*Dasypus novemcinctus*). There is also the illegal harvesting of marine turtle eggs and poaching of adult turtles. Extensive forest exploitation is undertaken by local populations as a means of subsistence. However, the Royal Palm (*Manicaria sp.*) is more intensively exploited by commercial loggers and hotels.

Recreation and tourism: Ecotourism is an important activity in the HCN, mainly carried out in the sector adjoining the Parque Nacional Tortuguero.

Physical features

The environmental factors that influence the specific and very special conditions of the HCN the most are hydrology, topography and humidity. The HCN is located in the hydrographical basin of the San Juan River, which covers an area of 38,500 km² divided between Nicaragua and Costa Rica. This is the area of Costa Rica with the highest rainfall, at 330 days per year. In addition, it is the lowest part of Costa Rican territory, within the largest river basin of Central America. These factors contribute to the creation of flood zones, wetlands with abundant flora and fauna, and to the supply of fresh surface water and groundwater, which are necessary and important for forest life and the transportation of nutrients with sediments.

The average annual discharge from the San Juan River in the entire river basin is 1860 m^3/s. The upstream flow of the river basin, at the source itself of the San Juan River in the Nicaragua Lake, is relatively low at around 450 m^3/s. The flow increases considerably downstream thanks to the affluents of the rivers San Carlos, Sarapiqui, Frío, Zapote and other rivers located on the Costa Rican side of the San Juan river basin. Approximately 30 kms before reaching the San Juan river delta, it branches off with the Colorado River in Costa Rica. From this point, and up to the mouth of both rivers, the San Juan river flow divides into two very distinct discharges; the Colorado River takes 80% of the total volume of water, while the San Juan River takes the remaining 20%.

Average annual rainfall on the Costa Rican side of the San Juan river basin varies from 2,000 to 3,000 mm on average annually upstream of the river, and from 5,000 to over 7,000 mm downstream of the river, near to the mouth of the San Juan and Colorado rivers in the Caribbean Sea. The Isla Calero area is the only territory in the entire HCN that corresponds to a transition zone from pre-mountainous to low level rainforest. The rainfall range is between 4,000-7,000 mm, with an average temperature of 24° C.

Another very important aspect within the San Juan river basin is groundwater discharge.

Groundwater in the river basin, on the Costa Rican side, is contained in aquifers, with groundwater discharges on three different scales. The formation of aquifers begins to the south-west of the HCN on the border of the continental watershed, clearly marked by the presence of a mountain chain composed mainly of the Poas, Barba and Irazu volcanoes. This mountain chain is formed essentially by Cenozoic volcanic rocks, which extend for tens of kilometres towards the east and north-eastern route to the Caribbean Sea. Before reaching the sea, these are interspersed with Mesozoic sedimentary rocks. Between the mountains of the south-east and the coast, the two rocky formations form aquifers fractured down the middle with double porosity of considerable thickness and with a horizontal groundwater discharge on a regional scale (over 100 kilometres). The recharge of these aquifers is mainly effected by direct infiltration of rainfall through the volcano slopes and indirect infiltration along the plain. It should be noted that the rainfall in the area of volcanoes and on their steep slopes is quite high, in the order of 7,000 annually. The latter is reflected in a substantial aquifer recharge, which causes very high water pressure, enabling groundwater discharge to take place on a regional scale.

On a more intermediate, and especially local, scale, upstream of the Costa Rican side of the river basin there are far shallower aquifers and groundwater conditions, basically composed of alluvial sediments. The latter receive their recharge directly from localized rainfall. Despite the thickness of the local aquifers being much more restricted, their discharge plays quite an important role in regulating the hydrodynamics of the wetlands.

It is very important to take into consideration groundwater discharge in both regional and local aquifers, as this enables the hydrodynamic balance of salt water intrusion in the HCN sector to be maintained.

The water balance of the San Juan river basin means that substantial volumes of water can be observed in both countries. The water balance distribution represented in annual volume and in percentages of total annual rainfall is shown in the following table.

	Mm	10^6 m³/year	% of rainfall
Rainfall	1,860	71,610	100
Real evapotranspiration	924	35,574	49.7
Total surface run-off	780	30,030	41.9
Infiltration	156	6,006	8.4

Taking into account the total volume of surface run-off per year into the San Juan river basin of 30 km³ and, considering that 80% of this originated from the Costa Rican side, it can be said that a volume of 24 km³ of water discharges into the HCN area, maintaining the hydrodynamic balance of the Refugio de Vida Silvestre Corredor Fronterizo and the Refugio de Vida Silvestre Barra del Colorado in Costa Rica. This volume alone represents around 20% of the total renewable water resources of Costa Rica.

Fluvial Dynamics

Downstream, the San Juan river divides and discharges into the Caribbean Sea, near to San Juan in Nicaragua and in Barra del Río Colorado in Costa Rica. In both cases a delta is formed, due to the low terrain slope, a larger river cross-section and the amount of the water discharge, creating extensive lateral development, with the formation of meanders and braided areas. This type of fluvial system is characterized by many channels separated by sandbanks and small islands, with abundant sediment loads. During periods of high discharge, the river's volume of water is quickly overloaded with sediments, forming sandbanks around which the current is diverted. The continuous formation of these sandbanks, and the consequent separation into channels, gives rise to the braided aspect of this fluvial system. The sediments come from natural erosive processes and soil loss, aggravated by poor agricultural practices, inappropriate forest exploitation techniques and the lack of soil and water conservation practices (Procuenca de San Juan, 2004).

The suspended sediments consist mainly of sand (20%), silt (18%) and clay (62%), with a calculated mass at the Lake Nicaragua outlet of 190-763 Ton/day (Procuenca de San Juan, 2004). This substantial sediment load gives the waters of the Colorado and San Juan rivers their characteristic colour. The process is also reflected in the Caribbean Sea because of the presence of a plume of fine sediments, which is transported in the stratum of fresh water above the halocline. 80% of the bottom sediments are stored downstream of the river basin and along the coastal strips, represented by beaches, which restrict the formation of an estuary due to incoming waves and/or sea currents.

The fluvial dynamics of the San Juan river determine whether a delta with a wide lateral development is created, giving rise to numerous discharge channels, which, when displaced laterally, may leave isolated meanders. The latter provide the main mechanism for the formation of the swamps, lakes and lagoons found in the HCN. The biodiversity in the area is natural and in a permanent process of spatial adjustment, depending on the dynamics of the San Juan river delta. Any change in such a pattern due to natural processes (e.g. floods) or anthrophic events (e.g. channelling, water transfer, damming) would therefore alter the distribution and abundance of species.

Geology

Geologically speaking, the territory of Costa Rica is very recent. Scarcely 50 million years ago, this small, mountainous strip was part of the ocean floor, like the rest of the Central American isthmus between Guatemala and Colombia. Current thinking by geologists is that for 40 million years and up until only the last three million years, Costa Rica and its closest neighbours were merely a volcanic archipelago.

Using the continental shift theory (tectonic plates), the formation of the Costa Rica mass can be explained by its position on the west bank of what is known as the Caribbean Plate, which is shifting towards the west, thus displacing the Cocos Plate, which is located in the Pacific Ocean. The result of these two plates converging is volcanism.

The oldest volcanoes in the area were submerged. As the layers cooled, volcanic matter was deposited until finally the peaks emerged above the ocean surface. Thus, a chain of volcanic islands formed in a parallel line to the east of the contact area of the two plates. With the passing of millennia, the eruptions continued to send volcanic matter down their slopes, thus filling the areas around their bases. Only three million years ago, the interrupted land “bridge” between North America and South America was completed, allowing the movement of plants and animal species in both directions. This land bridge between the two continents is largely responsible for the immense biodiversity found in such a small area known as Costa Rica.

The other prominent factor that explains the country’s tremendous variety of flora and fauna is the very wide range of climatic conditions as a result of temperature and rainfall changes between the mountains in the centre of the country and the coasts with the two oceans. On the Atlantic side (Caribbean Sea), there are also intercalated older sedimentary rocks from the Mesozoic and Cenozoic eras (between 60 and 6 million years).

During the Quaternary period (Pleistocene and Holocene: two million years to ten thousand years respectively), coastal plains were formed with fluvio-lacustrine sediments on the Caribbean Sea side, largely covering the volcanic and sedimentary rocks and thus creating the plains observed today. This system of alluvial matter has created a series of high intermountain valleys, coastal valleys and plains, river channels and alluvial deltas; all of which are of fluvial origin. The geomorphology in this region located between the volcanoes and coast is such that there is a great variety and heterogeneity of fluvial zones, alluvial fans, recent fluvial plains, pleistocenic fluvial plains, coastal sandbanks and swamps (peatlands).

The geological and geomorphological characteristics of the San Juan river basin, which is where the waters that form the wetlands of the Caribbean coast originate, are very particular and correspond both to the geological traits (volcanism and sedimentation) previously discussed and the hydrographic features formed during the Quaternary period.

The soils in the area are typically sandy, silt, clay-silt and clay. The sandy soils are a product of sedimentation, which form parallel sandbanks in the coastal zone that emerge a few metres above the median groundwater level, leaving indented areas in between providing variable floodability. These form lagoons, grass or wooded swamps. These systems are fed by direct rainfall and poor drainage, thus creating areas of recharge to the shallow groundwater aquifers existing in the area by direct infiltration.

The depth of groundwater levels in the region varies between 30 cm in Dos Bocas (Indio River), to 80-100 cm in Viejo San Juan del Norte, and 85-100 cm in Nuevo San Juan del Norte (banks of the Indio River). The depth and area covered by these groundwater levels show the very important presence of very shallow groundwater aquifers in the region.

4. Current situation

4.1 Area where there are changes in the conditions of the Humedal Caribe Noreste

As stated in the request made by the Government of Costa Rica, the area of the Humedal Caribe Noreste (HCN) where changes in the ecological characteristics can be observed is located on the Isla Portillos (according to the map of Punta Castilla, scale 1:50,000 IGNCR 1970), demarcated by the right bank of the San Juan River to the west, the Caribbean Sea to the north-northeast and the coast to the south-west of the Laguna los Portillos towards the town of Aragón. For the purposes of this report, this area is called the area of direct influence and comprises approximately 225 ha of wetlands on the Isla Portillos. The coastal zone from the mouth of the San Juan River to the mouth of the Colorado River and the San Juan river delta and the remainder of the wetlands located on the Isla Portillos is considered the area of indirect influence.

In the zone adjacent to the aforementioned area can be found the Laguna los Portillos, which forms part of the Refugio de Vida Silvestre del Rio San Juan Ramsar Site in Nicaragua.

The background information provided by the Ministry of Environment, Energy and Telecommunications of Costa Rica (Ministry of Environment, Energy and Telecommunications, National System of Conservation Areas SE-1965, 15 November 2010) on the events that took place in the area of Isla Portillos, in the extreme north of the Humedal Caribe Noreste, highlights the following:

- A dredging operation on the river-bed of the San Juan river in the western sector of the Laguna los Portillos.

- Deposits of sediments from the San Juan River on the HCN wetland in the area of the Isla Portillos. The estimated quantity of sediment is 1688^3 (0.24 ha).

- Removal of vegetation from the HCN wetland (forest and undergrowth); the area cleared is 5.75 ha, divided into 1.67 ha of trees (N=197) and 4.8 ha of undergrowth.

- Flooding of land by constructing an artificial canal.

The Ministry of Environment, Energy and Telecommunications stated in its communication that the purpose of the changes was to prepare the area for the construction of an artificial canal to unite a body of fresh water with a body of salt water between the Aragón sector of the San Juan River and the Laguna los Portillos and the Caribbean Sea, thus changing the role of the sandbanks to control the sediment flux that is currently carried by the river, and causing a rupture in the balance of the wetland.

5. Assessment of the change in ecological characteristics

Described below is an assessment of the main changes in the ecological character of the wetlands situated in the area defined in point 4, based on relevant technical documents, photographs and satellite images.

Physical features

Changes in the wetland's local groundwater aquifer recharge

The most evident and direct change in the area affected on the island wetland of Isla Portillos is the change in the recharge pattern of the shallow groundwater aquifer, which is located directly beneath the wetland. As explained before, the local-scale (site) aquifers are recharged by direct rain infiltration. However, if deforestation continues, water retention in the soils above groundwater level will diminish and therefore the local aquifer recharge will also diminish. Although it is clear that this effect will be very localized to the island and to the south of the southern edge of the artificial canal, this would lead to consequent changes in the dynamics of the aquifer with respect to the surface run-off and changes in the island's flora. It should not be forgotten that plants and trees soak up water through their fairly shallow roots of less than one metre deep.

Change in the hydrographic network

It is estimated that the changes in the hydrographic network of the San Juan River are minimal at the river basin level, but significant at the wetland level. By connecting the San Juan River hydraulically with the Laguna los Portillos, the network's surface run-offs will be altered. This effect will only be felt, however, on a very local scale (island wetland and south of the artificial canal) if the volume of water of the San Juan River is not changed but simply diverted to the lagoon. On the other hand, if the San Juan River is also dredged upstream of the site, its volume of water will increase and there would be a wider effect.

Changes in the surface-water hydrology

Given the artificial hydraulic connection between the San Juan River and the Laguna los Portillos, it is evident that there is, and will continue to be, further changes in the local surface-water hydrology. The changes are apparent in the change in the river's rates of discharge and transportation of sediment between the river and the lagoon. Similarly, the consequent effect will be a possible change in the local water balance.

On the other hand, the existing hydrodynamic balance in this area, from the Pleistocene-Holocene era (see the section on geology) will be altered, with a consequent change in the water quality of the halocline.

The process and capacity to retain sediments and nutrients in and around the island wetland affected will be altered and there will be a drastic change in flood control and sedimentation flux.

Soil

Soil changes can be expected due to the flooding of the island wetland affected through increased permanent saturation and higher than normal sediment deposits. This will lead to changes in the geochemical characteristics of the soil due to this permanent flooding. Sediment from the San Juan River will alter the original structure of the soil in the island wetland, since the soil particle size (sand, silt, clay) and the ionic exchange with the shallow saturation will be mixed with the different sediments and water quality provided by the San Juan River and diverted towards the Laguna los Portillos via the artificial canal.

Geomorphology and groundwater hydrology

The geomorphology in the localized region between the volcanoes and the coast is very varied and heterogeneous; this is even more marked in the fluvial zones, alluvial fans, recent fluvial plains, Pleistocenic fluvial plains, coastal sandbanks and swamps (peatlands).

The formation of the delta in the area assessed was a slow process that had been developing since the beginning of the Quaternary period, aided by the particularly powerful dynamics of the San Juan River. The San Juan river flow and the transportation of sediments along it, has formed a micro system, creating both the Laguna los Portillos and the island wetland. The formation of local aquifers in highly-permeable porous media with a very shallow groundwater level (centimetres to a metre maximum) has given this area very particular geomorphologic and hydrogeologic characteristics. It is estimated that thousand of years' ago the site experienced a hydrodynamic balance with possible extreme hydrological events due to hurricanes. However, over the medium and long term, the system reached a steady state.

Current anthropogenic changes could alter this hydrodynamic balance with substantial changes in the geomorphology of the local groundwater aquifer. For example, the fluctuations in the local groundwater level could be altered, as could the delta's process of integrated dynamics by the transportation of direct sediments from the San Juan River to the Laguna los Portillos. In the absence of a more detailed study, however, it is difficult at this time to make a quantitative assessment of both the magnitude and duration of such changes.

Ecosystem components

Water

<u>Change in water quality due to an increase in volume of fresh water over the estuarine system of the Laguna los Portillos</u>

The Laguna los Portillos currently acquires its water supplies from the San Juan River, controlled mainly by variations in level in the river mouth sector, acting as a system of communicating vases, and from the superficial aquifer. It could possibly receive supplies from marine waters, as happens in the Laguna de Tortuguero, but they would in no way control the water balance of the Laguna, but would rather be a supply of salts. If the aquatic system were to receive a high volume of water from the San Juan River via the artificial canal, it would then be controlled hydrodynamically and thermally by such a supply, altering physical behaviour, water quality and therefore the ecology of the lagoon, reducing the system's overall production.

Change in the trophic state in the Laguna los Portillos due to a reduced residence time

The trophic state of the Laguna los Portillos is controlled by its residence time, supply of nutrients from the San Juan River and vegetable organic matter, which comes directly from the surrounding vegetation. It there was a supply of sea water, the bottom of the lagoon could produce a halocline that might contribute to the process known as "internal recharge", generating an additional nutrient supply from lagoon sediments. The aforementioned would result in a eutrophic water body, represented mainly by abundant aquatic vegetation, which is characteristic of the water bodies of lakes and lagoons in the HCN. Reducing the water residence time of the Laguna los Portillos, by the increased water supply from the artificial canal, would cause a reduction in the trophic state in the short term by the leaching of nutrients, loss of the internal recharge and inflow of water with a higher sediment content. It would probably significantly reduce the aquatic plant coverage and abundance of phytoplankton in the Laguna los Portillos, with a consequent effect on the trophic web structure.

Change in water quality due to an increase in volume of fresh water on the island wetland of Isla Portillos

The island wetland of Isla Portillos acquires a water supply from rainfall and groundwater supplies, which control surface and soil interstitial water quality. Both supplies have a low total suspended solid content; however, interaction with the tree line enriches them with humic compounds, which account for the turbid colour characteristic of the wetland waters. Receiving waters directly from the San Juan River with a high suspended sediment content would alter the surface and interstitial water quality of the island wetland, increasing its turbidity towards a more inorganic matrix.

Change in the superficial aquifer quality of the island wetland due to the influx of water from the San Juan River

Water quality from the superficial aquifer is controlled by groundwater influx and infiltration of rainfall falling directly over the wetland and Laguna los Portillos. Receiving a water supply from the San Juan River via the artificial canal, with a different quality, would alter the water quality infiltrating the aquifer, a process that will increase if the river's volume of water rises, since it will extend the area of flooding and thus the infiltration area.

Change in the trophic state of the island wetland

The trophic state of the wetland, where grass marshes and/or wooded swamps predominate, is fundamentally controlled by the superficial aquifer level, by maintaining a stable groundwater level, with variations related to the precipitation-evaporation balance. Receiving the water supply from the waters of the San Juan River via the artificial canal would alter the water balance, initially increasing the superficial aquifer level and reducing production of vegetation by flooding the vegetation, and later reducing the aquifer level through the possible breaching of the sandbank that encloses the Laguna los Portillos, thereby inducing water stress through drainage. In both cases the trophic state of the wetland will be reduced.

Flora and vegetation

Change in the vegetation cover due to land clearing in the island wetland

Land clearing is a process that has an irreversible impact on vegetation cover in the wetland (trees and undergrowth), since in areas with high rainfall rates, such as the HCN, the soil and seed bank are lost. The process is exacerbated by the effect of fluvial erosion.

<u>Change in the abundance and distribution of aquatic species in the Laguna los Portillos and island wetland</u>

As highlighted above, the construction of the artificial canal could change the hydrodynamic and thermodynamic conditions, water quality and trophic state of the Laguna los Portillos and island wetland, which are processes that determine the distribution and abundance of aquatic species in the lagoon and shallow bodies of water of the wetland. Initially, by increasing the water level and reducing its salinity, the abundance of aquatic species will diminish, with changes occurring in their composition, and they will subsequently be leached by the waters of the San Juan River whenever the sandbank currently separating the Laguna los Portillos is breached.

<u>Change in the abundance and distribution of terrestrial species in the island wetland</u>

The clearing and flooding of the wetland could affect the distribution and abundance of terrestrial species due to water stress, caused by excess water, and the subsequent drying out of the wetland if the sandbank is breached.

<u>Change in the growth rate of vegetation species in the island wetland</u>

The effect of water stress on terrestrial plants is a reduced growth rate (flooding-drying out), a process ending in the death of individual species. The result would be a change in the distribution and abundance of species.

Fauna

Change in the abundance and distribution of aquatic species, especially fish, in the Laguna los Portillos and the island wetland

In the Winemiller and Leslie study (1992), it is stated that the existing great wealth of fish in the lagoons is due to the presence of large structural heterogeneities. This pattern will be altered by the construction of the artificial canal, since the hydrodynamic and thermodynamic conditions, water quality and trophic state of the Laguna los Portillos and island wetland would be altered, making it more of a lotic than a lentic system. In the Laguna los Portillos, the vertical structure will be lost, homogenizing the water column, and in the wetland the bodies of water would be replaced by an extensive flood zone.

Loss of aquatic habitat by transforming it from a lentic into a lotic condition

The construction of the artificial canal will transform the Laguna los Portillos and wetland island into a system with lotic-type dynamics, where the main gradient is longitudal, losing vertical and lateral heterogeneity. This change in the dynamics of the ecosystem would lead to a reduction in the wealth of habitats available for fauna; the transformation will be from an ecosystem with numerous habitats (structural heterogeneity) to a single, more extensive habitat dominated by the condition imposed by the San Juan River.

Changes in the trophic chain and reproductive success of aquatic species in the Laguna los Portillos and island wetland

Reducing the water residence time, through a greater influx of water from the artificial canal, would cause a reduction in the trophic state in the short term by the leaching of nutrients, loss of the internal recharge and inflow of water with a high sediment content. This process will reduce the recharge capacity and main energy source of the aquatic ecosystems (aquatic plants), forcing the metabolism towards a heterotrophic type, based on the use of organic matter transported by the waters of the San Juan River. This change in the carbon source that supplies the trophic web of the Laguna los

Portillos and island wetland involves changes in its organization and energy flows, altering the composition of species and their reproductive success.

Loss of habitat for species of migratory and resident birds in the island wetland and Laguna los Portillos

In addition to posing a problem for the ichthyofauna, the construction of the artificial canal would transform the Laguna los Portillos and island wetland into a system with lotic-type dynamics, where the main gradient is longitudal, losing vertical and lateral heterogeneity. This change in the dynamics of the ecosystem would lead to a reduction in the wealth of available habitats, including loss of the beach sector. In addition, the loss of aquatic vegetation in the Laguna los Portillos and island wetland may mean a reduction in the food supply for birds.

Change in the distribution and abundance of terrestrial species

The partial flooding of the wetland due to the construction of the artificial canal and the clearing of vegetation would alter the distribution and abundance of terrestrial species through the loss of habitat and reduction in food supply and shelter.

Fragmentation of natural biological corridors in the island wetland

The flooding of the area of the artificial canal would leave an important zone of the wetland (approx. 200 ha) isolated from the remainder of the wetlands located on the Isla Portillos, turning it into a barrier for terrestrial fauna with restricted mobility.

6. Possible scenarios

Described below are different scenarios that may occur depending on the magnitude and duration of the possible changes in the

Humedal Caribe Noreste, based on supplementary information that the RAM gathered during its visit.

6.1 Area of direct influence at local level

This scenario considers exclusively the enabling of the hydraulic connection between the San Juan River and the Laguna los Portillos, with no changes to the pattern of surface run-off.

Short term (between 3 and 6 months)

In the short term, changes are expected in the biogeochemical process rates and in the environmental goods and services prevalent in the HCN's area of direct influence, which correspond to changes in the quantity and quality of the water supply from the San Juan River. Currently, a direct effect on the habitats is being felt due to deforestation, soil excavation and the deposit of fluvial sediments.

Medium term (one year)

It is estimated that within an approximate period of one hydrological cycle (one year) there will be partial or total loss of the Laguna los Portillos. These changes are in line with the changes in the flow of surface fresh and sea water and the transport of sediments via the San Juan River. The sandbank currently separating the Laguna los Portillos from the Caribbean Sea is in danger of being breached due to the change in the hydrodynamic balance that maintains it between the flow of the San Juan River and the tidal limit. By connecting the San Juan River with the lagoon hydraulically by means of the artificial canal, both water flow and sediment transportation would increase and could destroy the sandbank. This could change the behaviour and morphology of the Laguna los Portillos, which is currently an estuarine lagoon, into a bay with higher salinity. These changes could take place within a hydrological cycle (six to twelve months).

On the wetland island, the flood zone might be extended, which will produce fluctuations in level depending on the hydrological dynamics of the San Juan River. This process could increase the water stress on tree and undergrowth vegetation due to flooding, giving rise to a growing halo of dead vegetation, with a loss of habitat for terrestrial fauna.

Long term (5 to 10 years)

In the longer term, between 5 and 10 years, it is expected that erosive processes on the wetland will be activated, due to the transformation of the Laguna los Portillos into a lotic system, triggering the removal and transportation of sediment towards the Caribbean Sea, as opposed to its current role as a sedimentation lagoon. This process might gradually change the shallow groundwater aquifer recharge beneath the island wetland. Depending on the volume of water carried via the artificial canal, the entire extent of the wetland could be eroded.

In addition, the wetland would be completely changed due to:

- the hydraulic and physical connection of the San Juan River with the Laguna los Portillos;
- the change in shallow groundwater aquifer recharge beneath the island wetland;
- the transportation of sediments; and
- the water quality of the Laguna los Portillos, whose morphology would be altered and it would change from a lagoon into a bay with more saline water.

6.2 Area of indirect influence

As mentioned in point 4.1, the indirect area of influence is defined as the coastal zone from the mouth of the San Juan River to the mouth of the Colorado River, and the San Juan river delta and the remainder of the wetlands located on Isla Portillos.

This scenario considers the enabling of the hydraulic connection between the San Juan River and the Laguna los Portillos and also prioritizing the water flow of the San Juan River, which currently discharges into the Caribbean Sea, towards the artificial canal.

Short term

In the short term, no changes in the area of indirect influence are expected, since the run-off patterns in the San Juan river delta are not altered by the hydraulic connection between the river and the Laguna los Portillos. As for the existing systems in the area of indirect influence, they will be within the range of natural variability.

Medium term

As a result of the loss of the sandbank separating the Laguna los Portillos from the Caribbean Sea, the area of indirect influence will suffer changes in biogeochemical process rates, in habitats and in environmental goods and services. This is due to a decrease in the volume of water and run-off velocity and a rise in the rate of sedimentation, increasing the trophic state of the body of water. Additionally, there is likely to be further erosion in the remainder of the wetlands on Isla Portillos (south-eastern bank of the artificial canal).

Long term

If the volume of water of the San Juan River is discharged mainly via the artificial canal, it would give rise to a change in habitat from a lotic to lentic condition. In functional terms, the sector of the Laguna los Portillos will progressively acquire the spatial configuration that currently exists in the mouth of the San Juan River, while the river mouth will acquire the current condition of the Laguna los Portillos. The root cause of these changes may be exclusively due to the alteration in the run-off pattern of the waters of the San Juan River when discharged via the artificial canal.

6.3 River basin level

This scenario considers the enabling of the hydraulic connection between the San Juan River and the Laguna los Portillos and also prioritizing the water flow of the San Juan River, which currently discharges into the Caribbean Sea, towards the artificial canal. It does not consider the diversion of the waters from the Colorado River to the San Juan River.

At the hydrographic basin level of the San Juan River (38,500 km²) no changes are expected in the water balance, with the exception of the dynamics of the salt water intrusion on the coast due to a breach of the sandbank in the Laguna los Portillos.

7. Conclusions

In the light of the advisory analysis carried out under the auspices of the Ramsar Convention and pursuant to the main aim, as per the Government of Costa Rica's request, of assessing the changes in the ecological character of the Humedal Caribe Noreste Ramsar Site due to the existence of dredging operations on the river-bed of the San Juan River in the western sector of the Laguna los Portillos and an artificial canal for the purposes of connecting both systems, the Ramsar Advisory Mission concludes that:

- According to the analysis of the technical information received from the Government of Costa Rica, there are changes in the ecological characteristics of the Humedal Caribe Noreste in the area of direct influence involving around **225** ha (**2.25** km²) or **0.3**% of the total wetland area (**75,310** hectares, or **753** km²).

- Aquatic system components, i.e. water quality, aquatic flora and fauna, and resident and migratory birds, would be the most affected.

- Although the analysis carried out is confined to the HCN, it is clear from the information analysed that the Laguna los Portillos, located in the Refugio de Vida Silvestre Río San Juan Ramsar Wetland in Nicaragua, would be the most affected, with the hydraulic connection with the San Juan river.

- If dredging operations continue in the San Juan River, the dredged sediments should not be deposited over the HCN wetland area.

- Should the changes continue in magnitude and extent on the San Juan river (as per the current situation), it is likely that the medium- and long-term scenarios described will become a reality.

8. Recommendations

To support the Government of Costa Rica in maintaining the ecological characteristics of this wetland, the RAM recommends:

- Due to its geographical location and dynamics closely linked to the Refugio de Vida Silvestre Corredor Fronterizo and to the Refugio de Vida Silvestre Río San Juan Ramsar Site, the preservation of the Humedal Caribe Noreste calls for substantial cooperation and collaboration between the two bordering countries of both Ramsar sites pursuant to the Convention’s guidelines for international cooperation.

- It is important to carry out rigorous environmental impact assessments for any project or activity that might affect the hydrology and hydrodynamics of the Caribe Noreste Ramsar Site and the Refugio de Vida Silvestre Río San Juan Ramsar Site.

- It is recommended that a system should be set up to monitor the ecological characteristics of Ramsar wetland sites and protected reserves on either side of the two countries, given the strong hydraulic connection and hydrodynamic balance existing on both sides.

- Sharing information on the physical, chemical and biological characteristics of the San Juan river is important, as well as on the wetlands of the Caribe Noreste and Refugio de Vida Silvestre Río San Juan Ramsar Sites.

- It is crucial to maintain the river discharge and patterns of the San Juan river upstream of the HCN in order to preserve it as a healthy and sustainable wetland in the long term.

- Deforestation of the HCN should be avoided so as to prevent the erosion and reduction of aquifer recharge.

- To maintain the current ecological conditions of the wetland, the surface run-off patterns should be restored before the sandbank of the Laguna los Portillos is breached.

- Taking into account the current state of the wetland and in the light of scenarios put forward, it is recommended that the Caribe Noreste Ramsar Site should be included on the Montreux Record.

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Annex 1

WORK PROGRAMME OF THE RAMSAR MISSION

Date and Time	Activity	Place	Participants
Saturday 27 November 2010			
	Arrival at Costa Rica Ramsar Mission, transfer from airport to the hotel		SINAC Wetlands Programme
Sunday 28 November 2010			
9.30 to 12 pm	Presentation of the incident by the Tortuguero Conservation Area and Experts: 1. Opening. 10 min 2. Site's location in context. 15 min 3. Analysis of actions taken to change use. 30 min 4. Sedimentological model. 30 min	Ministry of Foreign Affairs	Marco Vinicio Araya, MSc Dr. Luis A. Rojas Miguel Araya, Engineer Dr. Allan Astorga
12 to 1.30 pm	Lunch		
1.30 to 4 pm	Mission's meeting with Experts	Ministry of Foreign Affairs	Mission team Experts: Dr. Allan Astorga Dr. Juan Bravo Frederico Avilés, Engineer Miguel Araya, Engineer Marielena

			Herrera, MSc Marcos Araya, MSc Mariana Jiménez, Geog. Jorge Gamboa, BSc Dr. Luis A. Rojas Representative of the Ministry of Foreign Affairs
Monday 29 November 2010			
7 am to 12 pm	Overflight of Isla Calero and meeting in Barra del Colorado	Juan Santamaría Airport and Barra del Colorado	Mission team SINAC Wetlands Programme and ACTO
2 to 5 pm	Exchange of impressions on what was observed on the overflight	Ministry of Foreign Affairs	Mission team Experts
Tuesday 30 November 2010			
9 am to 12.30 pm	Discussion of Mission's report with national authorities and experts	Ministry of Foreign Affairs	Mission team Authorities and Experts Ministry of Foreign Affairs
12.30 to 2 pm	Lunch		
2 to 5 pm	Press Conference	Ministry of Foreign Affairs	Mission team Authorities and Experts Ministry of Foreign Affairs

Annex 2

Photographic Archive

The photographs and images used were provided by the Government of Costa Rica

[The Spanish original contains eight pages here with eight photographs, one map and three satellite images. Translations of the annotations are as follows:]

[Photograph 1]	**Laguna los Portillos**
	Cleared Area
[Photograph 2]	**Technical Inspection of Cleared Area**
	Photograph of 25 October
[Photograph 3]	*[No annotations]*
[Photograph 4]	**San Juan River and canal**
[Photograph 5]	**Area of Laguna los Portillos 5 December**
[Photograph 6]	**Laguna los Portillos and cleared area 5 December**
[Photograph 7]	*[No annotations]*
[Photograph 8]	**San Juan River**

[Map	*- title*	**Humedal Caribe del Noreste Ramsar Site**
	-right label	**Caribbean Sea**
	-legend	**Legend**
		Populations
		Wetlands = 151,018.49 Ha.
		Limón
	-right section 1	**National Location**
	-right section 2	**Global Location**
	-left label	**Pacific Ocean**
	-right label	**Atlantic Ocean**
	-credits]	**Produced by:**
		Roxana Pizarro Torres
		National Wetlands Programme
		SINAC-MINAE
		Sources:
		IUCN-MINAE Agreement
		SIG-SINAC, MINAE
		MOPT, populations and roads, scale 1:200000
		Date: September 2001
[Satellite image 1]		*[All annotations in English]*
[Satellite image 2]		*[All annotations in English]*

Annex 148

UNITAR/UNOSAT, "Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica" (Geneva, 2011)

4 January 2011

UNITAR

United Nations Institute for Training and Research

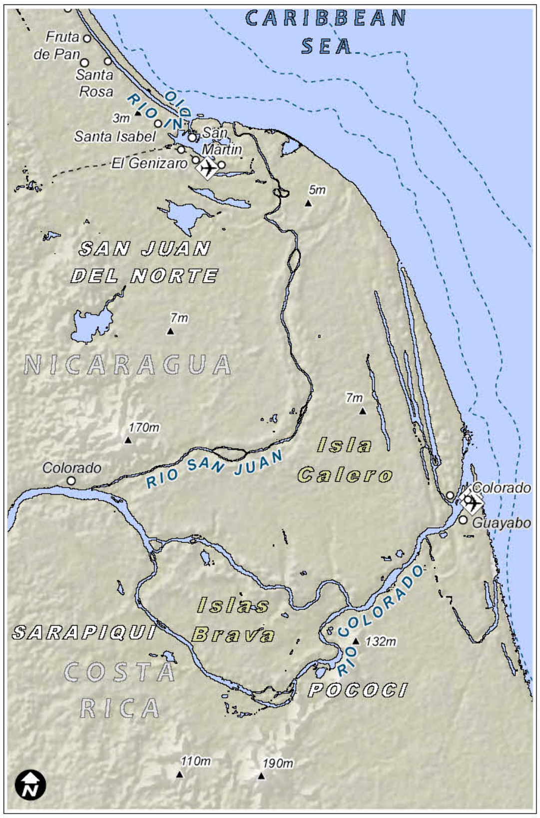
UNOSAT

Environmental Assessment

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

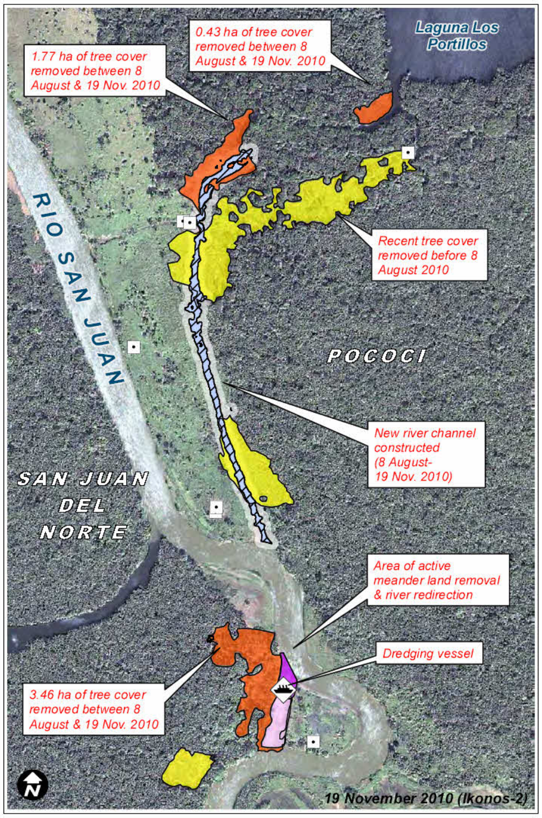
Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica

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

UNITAR / UNOSAT
unosat@unitar.org
Palais des Nations,
Geneva, Switzerland
T: +41 22 767 4020 (UNOSAT Operations)
24/7 hotline: +41 76 487 4998
www.unitar.org/unosat

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
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 16N
Datum: WGS-84

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.

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.

Contact Information:

Please send additions / corrections to UNITAR / UNOSAT:

unosat@unitar.org

Palais des Nations, Geneva, Switzerland

T: +41 22 767 4020 (UNOSAT Operations)

24/7 hotline: +41 76 487 4998

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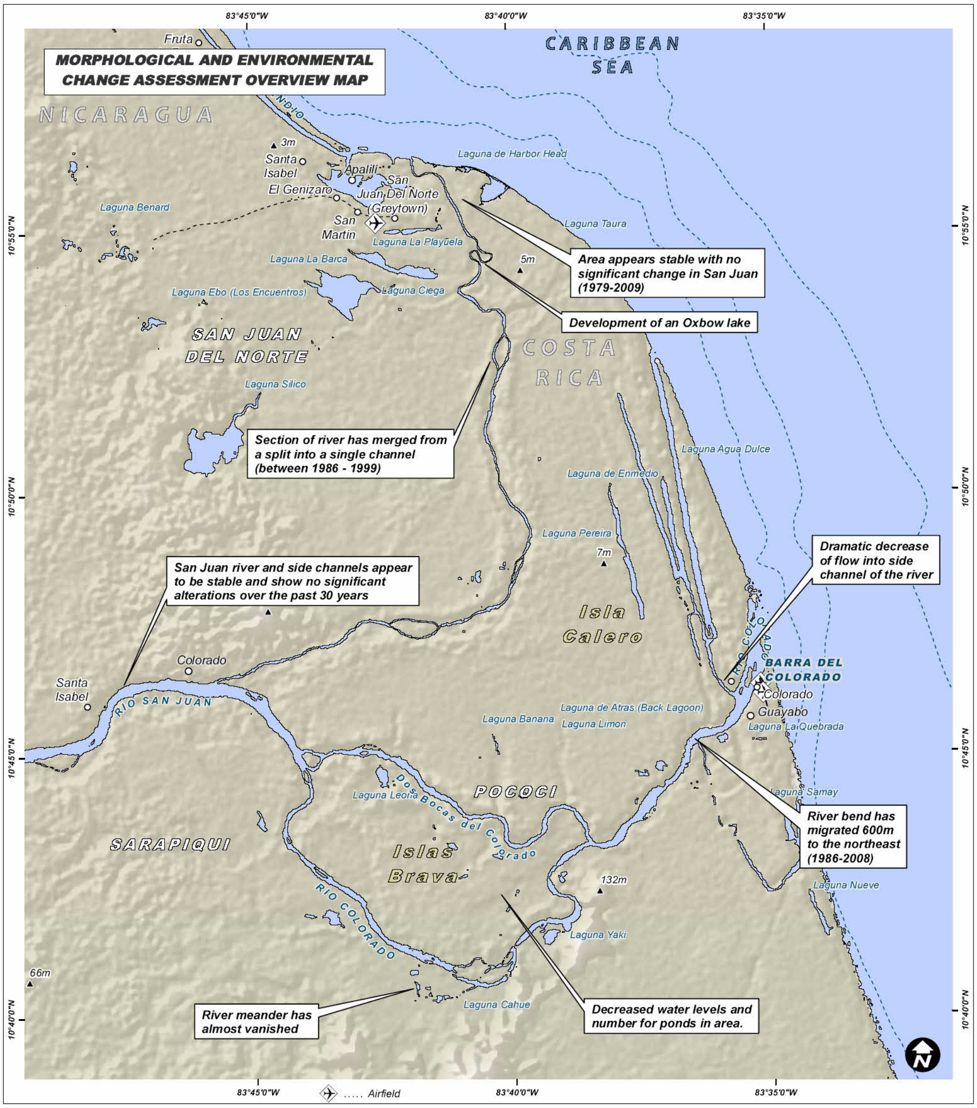

Map Scale for A4: 1:175,000

0 0.5 1 2 3 4 Kilometers

------ Track / Trail

▲ Spot Height (meters)

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Palais des Nations,
Geneva, Switzerland
T: +41 22 767 4020 (UNOSAT Operations)
24/7 hotline: +41 76 487 4998
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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
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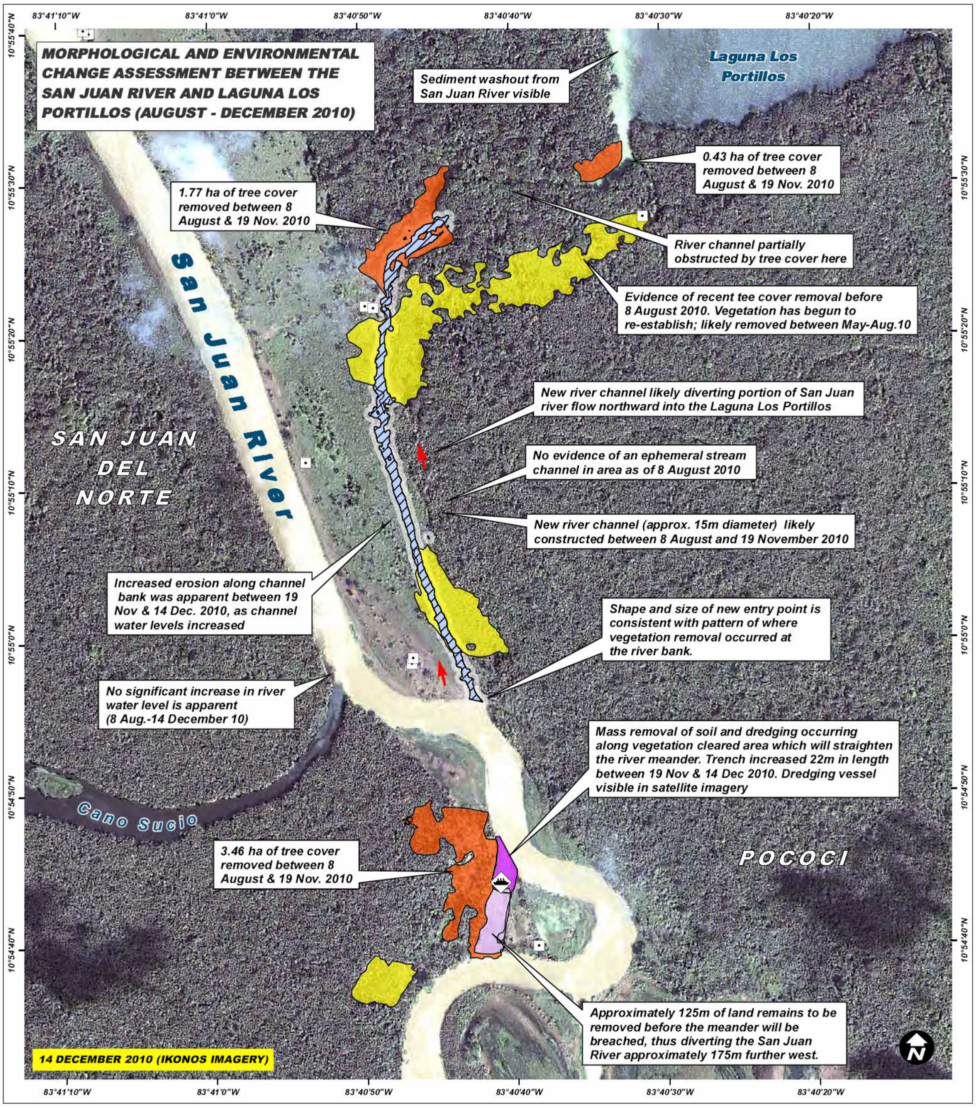

Building / tent structure

Dredging vessel

Area of likely future meander land removal

Map Scale for A4: 1:10,000

0 100 200 Meters

New Channel constructed between 8 August - 19 November 2010

Area of active meander land removal & river redirection (Between Nov.-Dec 2010)

Tree cover removed (recent) before 8 August 2010

Tree cover removed between 8 August - 19 November 2010

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emergencymapping@unosat.org
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4 January 2011
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Map Scale for A4: 1:10,000

0 100 200 Meters

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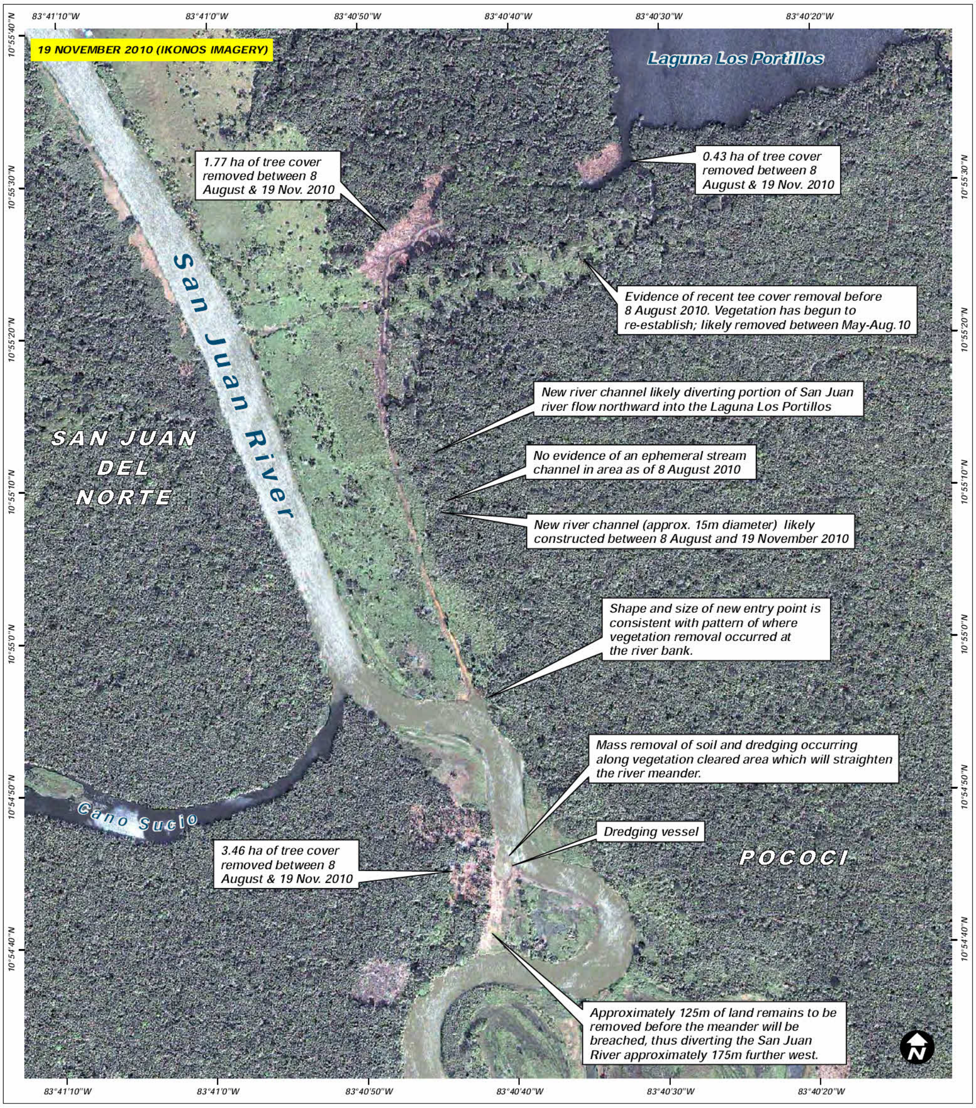

Map Scale for A4: 1:10,000 — 0, 100, 200 Meters

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Imagery Dates: 8 August, 19 Nov. & 14 Dec.2010
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Annex 149

UNITAR/UNOSAT, "Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica" (Geneva, 2011)

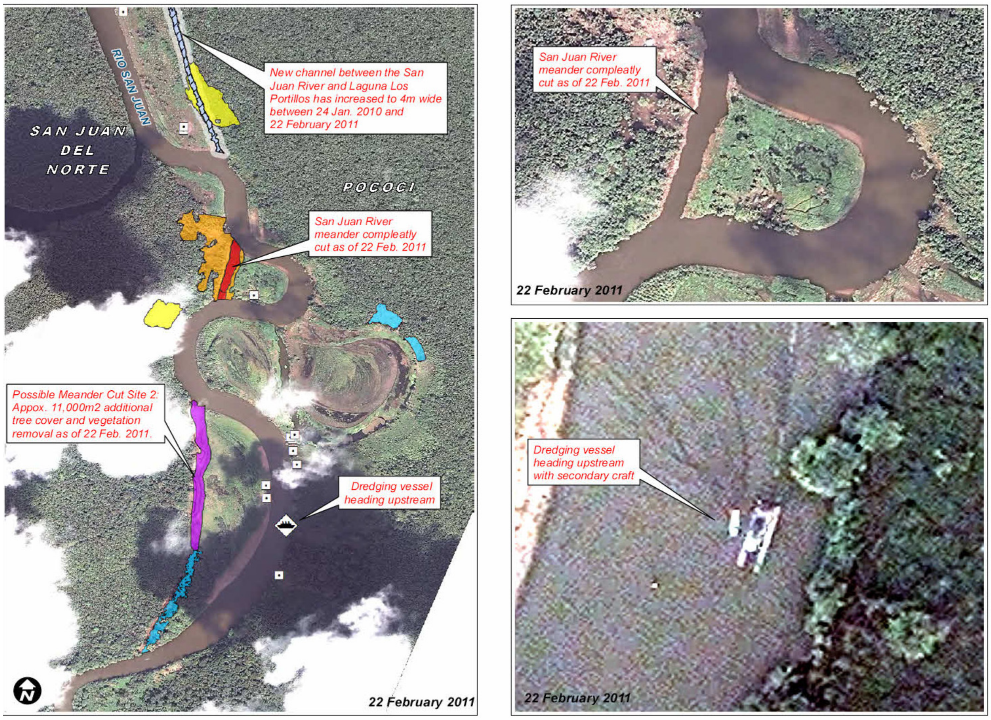
3 March 2011

unitar United Nations Institute for Training and Research UNOSAT Environmental Assessment

Production Date: 03/03/2011
10:00 UTC - Version 4.0
EN-20101229-CRI

Update 2: Morphological and Environmental Change Assessment for the San Juan River Area, Costa Rica as of 22 February 2011

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 22 February 2011.

Legend

- Building / tent structure
- Dredging vessel
- Completed meander land removal (Between 24 January & 22 February 2011)
- Tree cover removed between 24 January & 22 February 2011
- New Channel constructed between 8 August - 19 November 2010
- Area of active meander land removal (Between 24 January & 22 February 2011)
- Tree cover removed (recent) before 8 August 2010
- Tree cover removed between 8 August - 19 November 2010

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Palais des Nations,
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Satellite Imagery (1): WorldView2
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Imagery Dates: 6, 22 Jan.& 22 FEB. 2011
Source: Eurimage S.p.A
Copyright: DigitalGlobe 2011
Satellite Imagery (2): GeoEye and Ikonos
Resolution: 50cm and 1.0m
Imagery Dates (v2): 2 and 24 January 2011
Imagery Dates (v1): 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 17N
Datum: WGS-84
Spatial Analysis with ESRI (ArcGIS 10.0)

UNOSAT

03 March 2011 -10:00 UTC - Version 4.0 - EN-20101229-CRI

UPDATE 2 Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica

By UNITAR/UNOSAT – 03 March 2011

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

REVIEW OF THE NEW CHANNEL BETWEEN THE SAN JUAN RIVER AND LAGUNA LOS PORTILLOS:
There has been a slight increase in width of the new river channel. This is likely a result of the completion of the meander cut site 1 and the resulting slight increase of water velocity along that section of the San Juan River.

ANALYSIS SECTION 1: OVERALL REVIEW OF ASSESSMENT AREA (MAP 4)
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, except for those recent changes described below.

ANALYSIS SECTION 2: REVIEW OF MEANDER CUT SITE 1 & 2 (MAPS 1 - 3)
A time series analysis of satellite imagery recorded between 14 December 2010 and 22 February 2011 indicated that the dredging activity identified in the first report[1] over Site 1 has been completed with an estimated 6,070m2 of land removed reaching approximately 210m in length as of 22 February 2011 (see table 1 for a time series breakdown). This cut has created a side channel in the river diverting a portion of the San Juan River approximately 175m to the west.

As of 22 February 2011, there was significant additional vegetation and top soil removal along the west bank of the San Juan River 360m upstream of the first dredging site. The clearing has increased and now measures approximately 900m in length, 40m wide and 30,350m2 in area. Approximately 11,000m2 of additional tree cover and vegetation removal has occurred south of the original clearing extent. The vegetation and apparent top soil removal is linear in shape and follows the course of a creek upstream 360m to where the creek turns westward after which the clearing continues further south approximately 540m to the river edge. There has been some minor dredging of the northern edge of meander cut site 2 on the eastern bank of the creek mouth along the San Juan River and ending at the edge of the clearing. There has also been further removal of some remaining vegetation along the creek where clearing occurred previously; in particular trees have been removed at the mouth of the stream on the northern bank of the meander clearing. Considering the linear structure of the clearing and its proximity to the first dredging site downstream, it is probable 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
22 Feb. 2011	30m	210m

Table 1: Time series measurement of San Juan River meander dredging (site 1) between 19 November 2010 and 22 February 2011.

Contact Information:
Please send additions / corrections to UNITAR / UNOSAT:
unosat@unitar.org
Palais des Nations, Geneva, Switzerland
T: +41 22 767 4020
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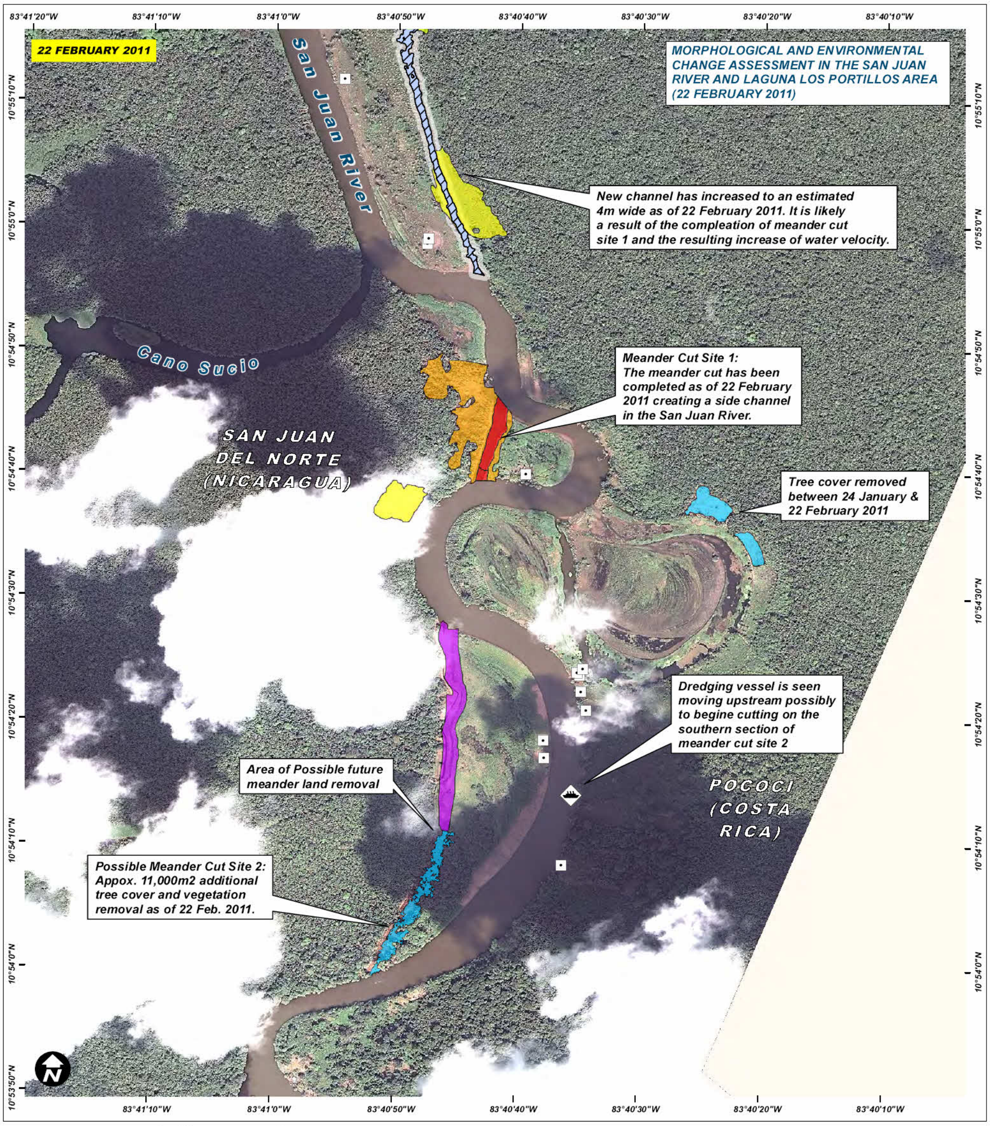

Building / tent structure

Dredging vessel

Completed meander land removal (Between 24 January & 22 February 2011)

Tree cover removed between 24 January & 22 February 2011

New Channel constructed between 8 August - 19 November 2010

Area of active meander land removal (Between 24 January & 22 February 2011)

Tree cover removed (recent) before 8 August 2010

Tree cover removed between 8 August - 19 November 2010

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Map Scale for A4: 1:12,500 — 100 50 0 100 200 Meters

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Imagery Dates: 6, 22 Jan.& 22 FEB. 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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Environmental Assessment
03 March 2011
10:00 UTC - Version 4.0
EN-20101229-CRI
83°40'45"W
83°40'40"W
83°40'35"W
10°54'50"N
10°54'45"N
10°54'40"N
10°54'35"N
22 FEBRUARY 2011
(MEANDER CUT SITE 1)
MORPHOLOGICAL AND ENVIRONMENTAL CHANGE ASSESSMENT IN THE SAN JUAN RIVER AND LAGUNA LOS PORTILLOS AREA (22 FEBRUARY 2011)
SAN JUAN DEL NORTE (NICARAGUA)
San Juan River
Meander Cut Site 1:
The meander cut has been completed as of 22 February 2011 creating a side channel in the San Juan River with the future potental of altering the course of the river approximately 175m further west.
Appox. 210m in length with 6,070 m2 of land removed
19/11/2010
14/12/2010
02/01/2011
22/01/2011
24/01/2011
22/02/2011
POCOCI (COSTA RICA)
N
Legend
Meander Cut Site 1 Progress Limit by date
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50 25 0 50 Meters
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Resolution: 50cm and 1.0m
Imagery Dates (v2): 2 & 24 Jan.2011
Imagery Dates (v1): 8 August, 19 Nov.14
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Source: European Space Imaging
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Protected Data: WDPA 2010 (UNEP)
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 17N
Datum: WGS-84

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03 March 2011
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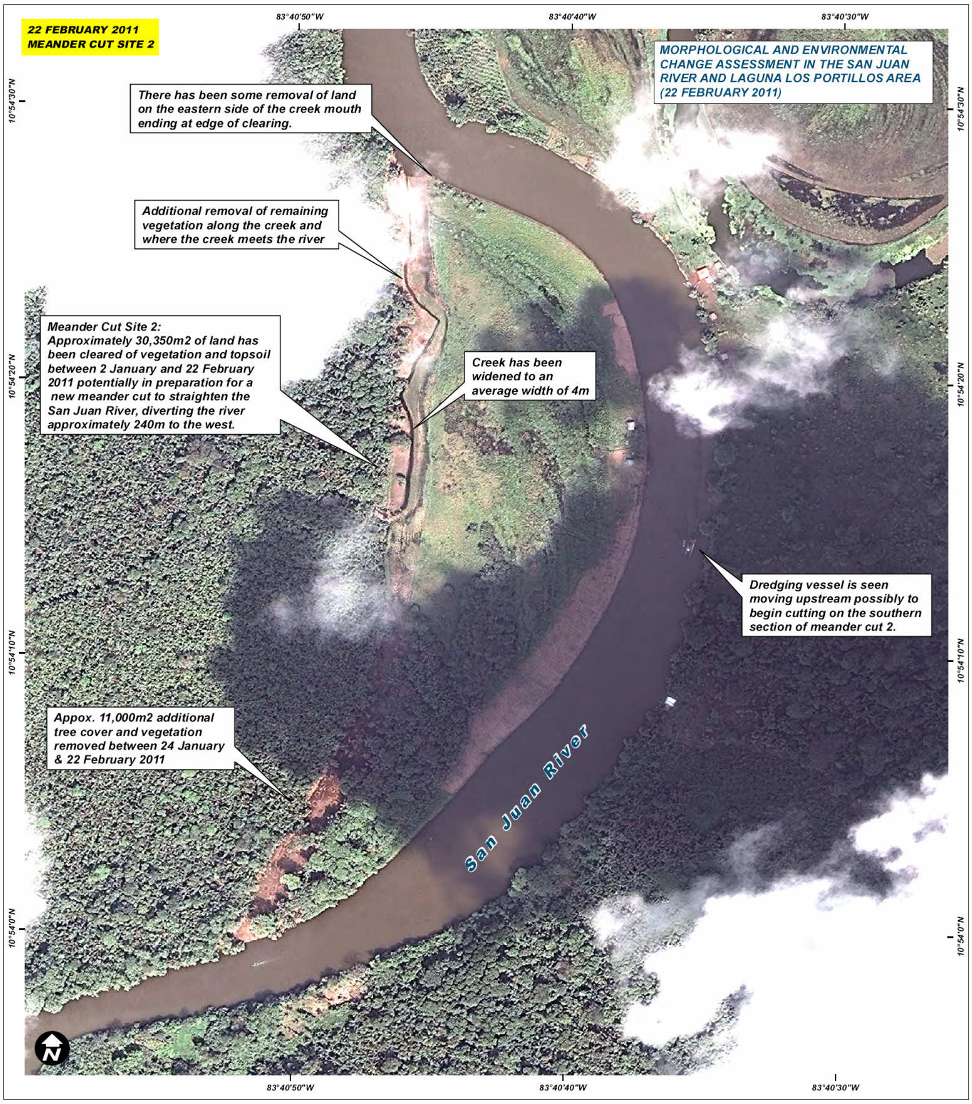

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Resolution: 50cm and 1.0m
Imagery Dates (v2): 2 & 24 Jan.2011
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Dec.2010
Source: European Space Imaging
Copyright: GeoEye 2010
Hydrology Data: UNOSAT, NGA
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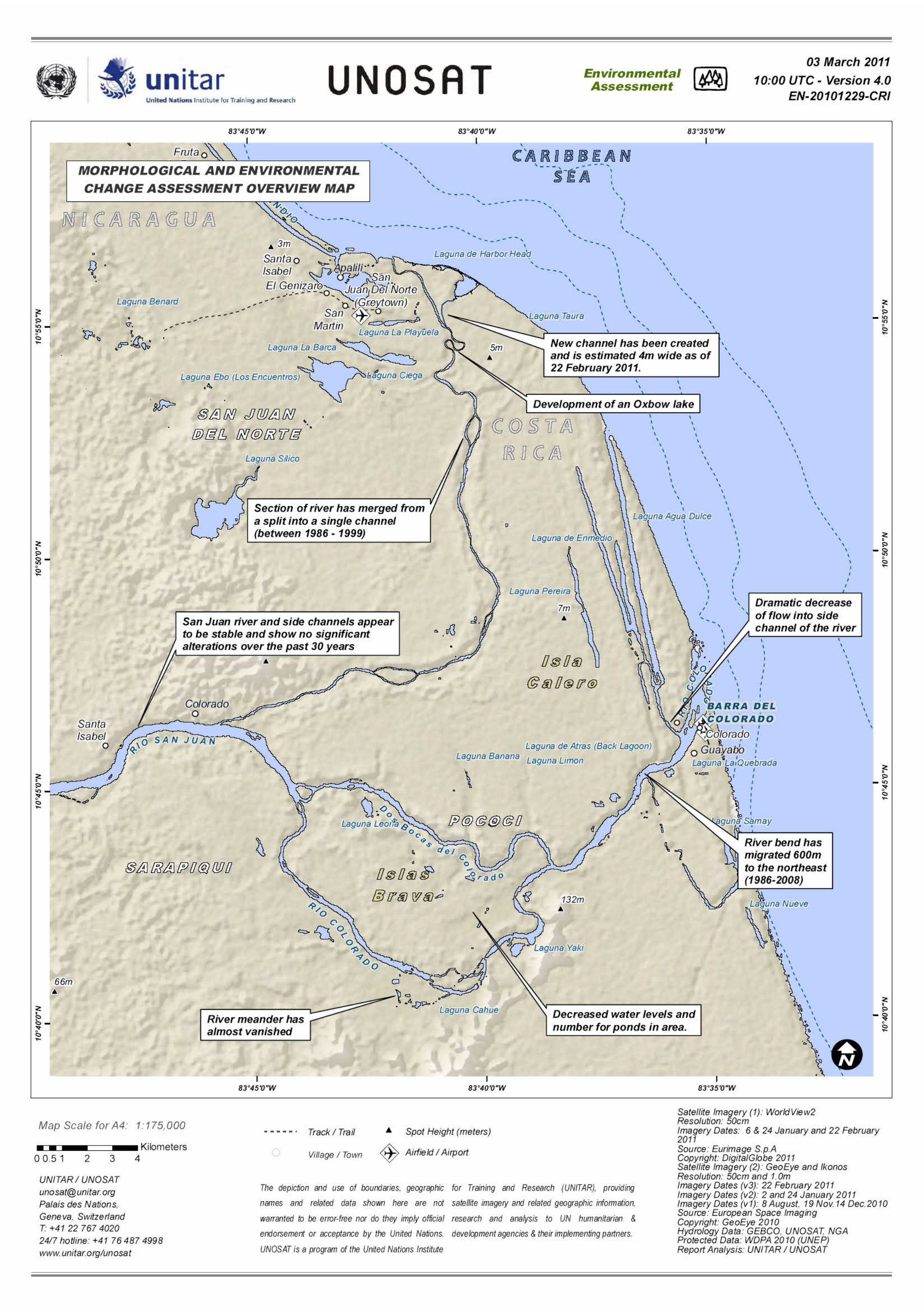
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 17N
Datum: WGS-84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MORPHOLOGICAL AND ENVIRONMENTAL CHANGE ASSESSMENT OVERVIEW MAP
CARIBBEAN SEA
NICARAGUA
COSTA RICA
SAN JUAN DEL NORTE
Isla Calero
POCOCI
SARAPIQUI
Islas Brava
BARRA DEL COLORADO
RIO SAN JUAN
RIO COLORADO
Dos Bocas del Colorado
Fruta
Santa Isabel
El Genizaro
Apalili
San Juan Del Norte (Greytown)
San Martin
Colorado
Guayabo
Laguna de Harbor Head
Laguna Benard
Laguna Taura
Laguna La Playuela
Laguna La Barca
Laguna Ebo (Los Encuentros)
Laguna Ciega
Laguna Silico
Laguna Agua Dulce
Laguna de Enmedio
Laguna Pereira
Laguna de Atras (Back Lagoon)
Laguna Banana
Laguna Limon
Laguna La Quebrada
Laguna Samay
Laguna Leona
Laguna Nueve
Laguna Yaki
Laguna Cahue
3m
5m
7m
132m
66m
New channel has been created and is estimated 4m wide as of 22 February 2011.
Development of an Oxbow lake
Section of river has merged from a split into a single channel (between 1986 - 1999)
San Juan river and side channels appear to be stable and show no significant alterations over the past 30 years
Dramatic decrease of flow into side channel of the river
River bend has migrated 600m to the northeast (1986-2008)
River meander has almost vanished
Decreased water levels and number for ponds in area.
83°45'0"W
83°40'0"W
83°35'0"W
10°55'0"N
10°50'0"N
10°45'0"N
10°40'0"N
Map Scale for A4: 1:175,000
0 0.5 1 2 3 4 Kilometers
Track / Trail
Spot Height (meters)
Village / Town
Airfield / Airport
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Imagery Dates: 6 & 24 January and 22 February 2011
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Copyright: DigitalGlobe 2011
Satellite Imagery (2): GeoEye and Ikonos
Resolution: 50cm and 1.0m
Imagery Dates (v3): 22 February 2011
Imagery Dates (v2): 2 and 24 January 2011
Imagery Dates (v1): 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

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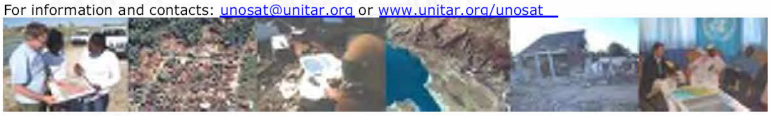

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Annex 150

UNITAR/UNOSAT, "Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica" (Geneva, 2011)

8 November 2011

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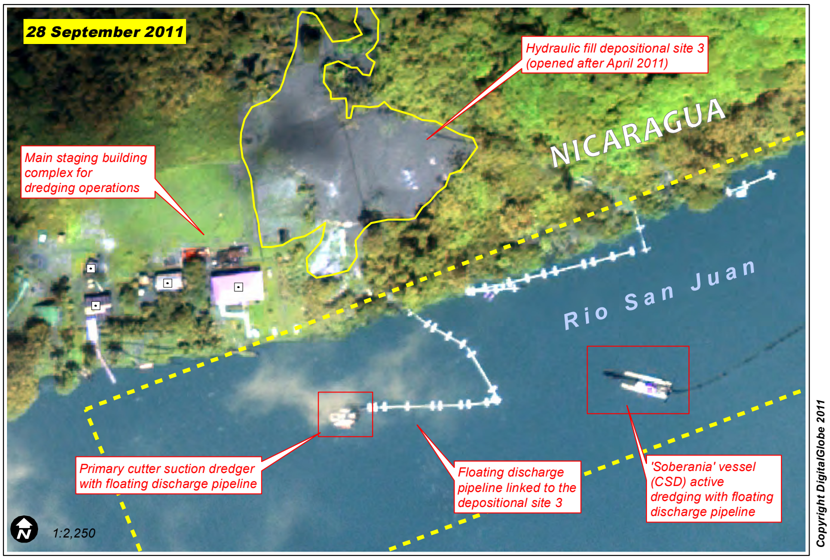
08/11/2011
Version 5.0

UPDATE 4: MORPHOLOGICAL & ENVIRONMENTAL CHANGE ASSESSMENT FOR THE SAN JUAN RIVER, COSTA RICA

(Covering the Period from 7 June to 25 October 2011)



Main staging area for the active dredging of the San Juan River at the divergence with the Colorado River:

UNITAR / UNOSAT
unosat@unitar.org
Palais des Nations,
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T: +41 22 767 4020
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Satellite Imagery: WV01/02, EROS-B, KS2, TerraSAR-X
Resolutions: 50cm, 80cm, 1m, 3m
Imagery Dates: 9 MAR, 7 JUN, 28 AUG, 28 SEPT, 17/25 OCT 2011
Sources: ASTRIUM, European Space Imaging, e-GEOS, Eurimage S.p.A, Infoterra GmbH
Copyrights: DigitalGlobe, GeoEye, SPOT Image, DLR2011
Administrative Data: UN-SALB
Transportation Data: NGA, UNITAR/UNOSAT
Protected Data: WDPA 2010 (UNEP)
Hydrology Data: USGS, UNITAR/UNOSAT
Elevation Data: GDEM/SRTM-JAXA-NASA
Report Analysis: UNITAR / UNOSAT
Projection: UTM Zone 17N
Datum: WGS-84
Analysis conducted with ArcGIS 10.0

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8 November 2011 - Version 5.0 - EN-20101229-CRI

UPDATE 4: Morphological and Environmental Change Assessment within the San Juan River Area (including Isla Portillos and Calero), Costa Rica

By UNITAR/UNOSAT – 8 November 2011

PREFACE: *This assessment of significant morphological, hydrological and/or other environmental changes along the San Juan River in 2011 was conducted at the request of the government of Costa Rica using a time series of commercially available satellite data recorded on eleven separate dates[1] throughout the year. This assessment was focused on two specific areas of interest along the northern border of Costa Rica: First, the divergence zone between the Colorado and San Juan Rivers (see Analysis Section 1); and second, the downstream segment of the San Juan near Laguna los Portillos (see Analysis Sections 2 & 3). Assessment findings were made with a high degree of confidence based on a detailed and exclusive assessment of satellite imagery using traditional imagery processing and photo-interpretation methods. These findings have not yet been validated in the field. Please see the reference overview Map 1 on page 3.*

FINDINGS SUMMARY: *There is a well-organized and sustained program of riverbed dredging along two separate locations on the San Juan River near the divergence with the Colorado River, and has been in operation since at least March 2011[2]. The presence of a new building complex adjacent to the dredging zone suggests a commitment to maintenance dredging necessary to preserve the expected improvement in vessel draft limits for this section of the San Juan. Although there are areas of recent vegetation removal in order to accommodate the open discharge of hydraulic fill removed from the riverbed, these depositional sites are located exclusively on Nicaraguan territory, and there are no indications of adverse environmental or hydrological impacts along the Costa Rican side of the border on the south bank of the river. A status review of the recently constructed channel linking the San Juan River with Laguna Los Portillos in the canton of Pococí, Costa Rica indicated that water flow has continued to decline and may have actually stopped altogether due to the accumulation of deposits along the channel bottom (e.g. silt/mud/misc. organic materials, etc) and the lack of recent maintenance dredging.*

ANALYSIS SECTION 1: REVIEW OF DREDGING ACTIVITIES AT DIVERGENCE OF RIO SAN JUAN AND RIO COLORADO (MAPS 2-3)

There is an active and sustained program of river dredging along the San Juan near the divergence with the Colorado River that has been in operation at least since March 2011. Over the last eight months this dredging activity has been concentrated in a zone (hereafter designated 'Zone 3') measuring approximately 450m x 100m in size (center coordinates 10.774N, -83.763W) and is functionally connected to a second dredging zone on the San Juan located 2km downstream (center coordinates 10.780N, -83.744W) that became operational between late September and 17 October 2011 (hereafter designated 'Zone 4'). Both dredging zones are presented in the overview Map 2 on page 6, with vessel locations annotated by date of detection.

There appears to be a single dredging vessel dedicated to Zone 3 since March 2011. Based on a review of the vessel structure and the floating pipeline configuration, the vessel is likely either a standard suction (SD) or cutter suction dredger (CSD) type. This dredging vessel was detected in a total of four separate image dates, in three of which it was the only active dredging vessel in the Zone. As identified in the imagery recorded on 28 September (see Map 3), this vessel was temporarily complemented by the dredging vessel 'Soberania' which was apparently relocated upstream after 28 August 2011. Between 28 September and 17 October 2011, the 'Soberania' was relocated again 2km downstream to initiate river dredging within the newly opened Zone 4 (see Figure 1).

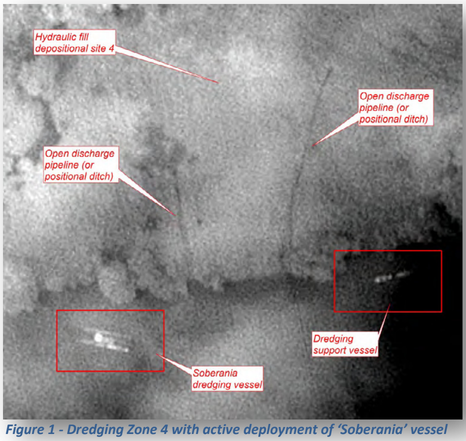
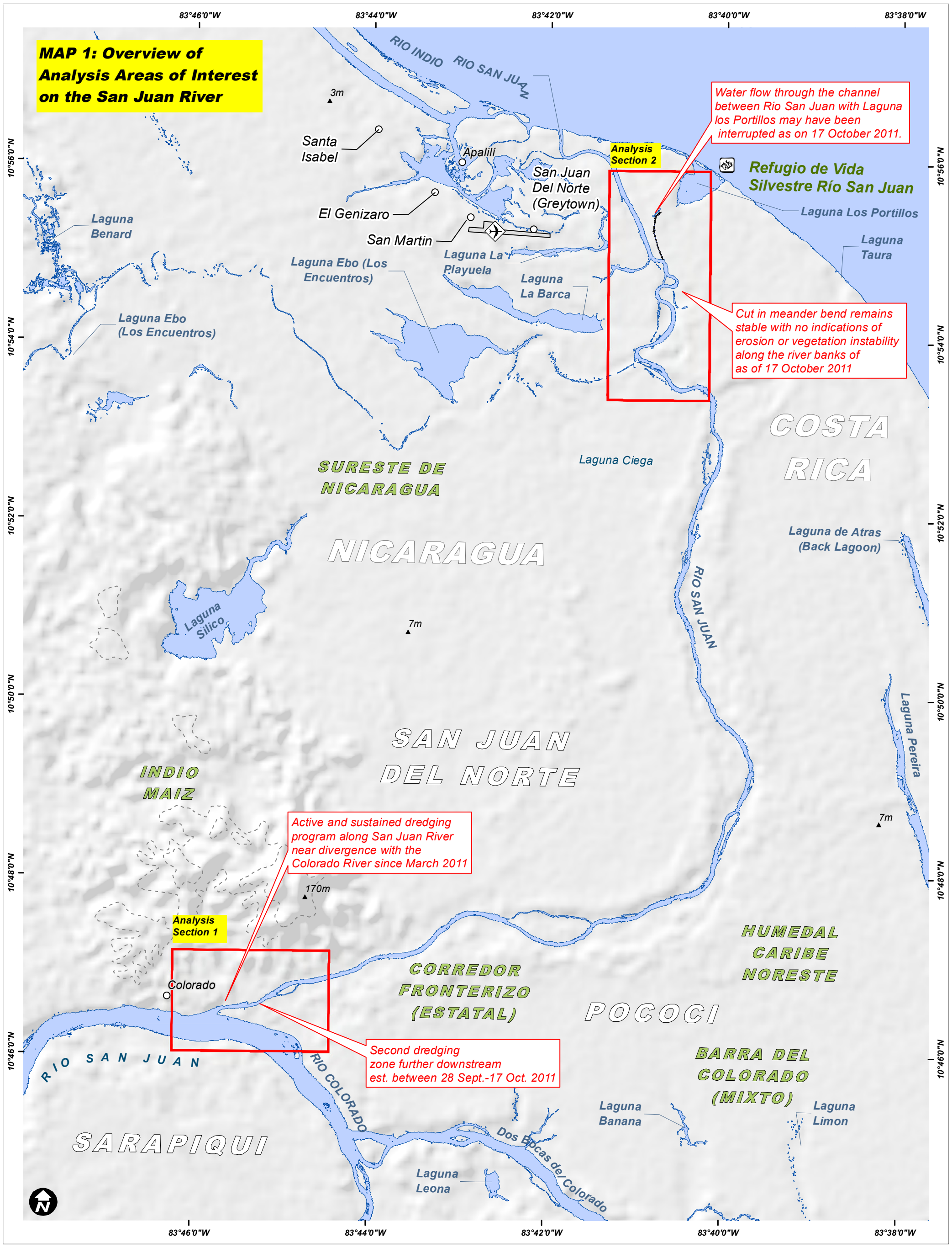


Figure 1 - Dredging Zone 4 with active deployment of 'Soberania' vessel (17 October 2011)

The well-organized dredging operation along the San Juan within Zone 3 is composed of three large depositional sites located on Nicaraguan territory, and are defined by the lack of vegetation cover and the presence of exposed, wet soils, with each site covering an average area of approximately 5,500m^2. These depositional sites are used for the open discharge of hydraulic fill removed from the riverbed by the dredging vessels (see the focus Map 3 on page 7). The hydrologic fill is deposited through floating

[1] *Imagery Dates used: 2,6,22,24 January, 22 February, 9 March, 7 June, 28 August, 28 September and 17, 25 October 2011*
[2] *The lack of earlier satellite imagery over this area in 2010-2011, has prevented a more precise date window.*



Map Scale for A4: 1:100,000

0.5 0.25 0 0.5 1 1.5 2 2.5 Kilometers

Regional water bodies as identified on 18 April 2011

New river channel water extent as on 19 Nov. 2010

Village / Town

Natural Park

Airfield / Airport

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pipelines connected to dredging vessels positioned on average between 30-60m offshore.

The first depositional site was open for discharge collection as on 9 March 2011, but later closed by 18 April and replaced with a second depositional site located 150m to the west. This second site was used alternatively by two separate dredging vessels, (including the 'Soberania'[3]) and may likely be closed at present. The third depositional site was opened between April and October 2011 approximately 200m west of the second site. As of 25 October 2011, this third depositional site appears to be operational, however it will probably need to be replaced with a fourth site soon if dredging is to continue within this section of the San Juan.

Adjacent to the third depositional site is a relatively large building complex composed of four main building units, a number of smaller support structures as well as a functioning dock. It is likely that this building complex was constructed in the context of the active river dredging, and suggests a permanent commitment to maintenance dredging in order to preserve likely improvements in vessel draft limits for this section of the San Juan.

A review of the vegetation cover changes in 2011 over both dredging zones 3 and 4 did indicate that approximately 4,600m^2 of tree cover was removed for the establishment of depositional site 2 and a further 5,500m^2 from site 3, while the other two depositional sites were located on previously existing open fields. There were no visible indications that this depositional activity has been occurring on or otherwise adversely impacting vegetation on the south bank of the San Juan within Costa Rican territory. Further, there are no visible indications at present that the dredging activity along this section of the San Juan River has had a significant environmental or hydrological impact along the Costa Rican side of the border.

ANALYSIS SECTION 2: UPDATED STATUS OF THE NEW CHANNEL ALONG RIO SAN JUAN (MAPS 4)

The apparent reduction in water flow along the newly constructed river channel[4] between the San Juan River and the Laguna Los Portillos was initially identified[5] as occurring between 22 February and 30 April 2011, and remained at significantly reduced levels through early June 2011. This observed reduction in water flow was likely due to the accumulation of deposits along the channel bottom (e.g. silt/mud/misc. organic materials, etc) which would necessarily restrict water flow as the deposits increased in relative depth.

Please see the reference overview Map 4 on page 8.A review of additional satellite imagery collected on 28 August and 17 October 2011 strongly suggests that not only has the water flow through this channel continued to fall since 7 June 2011 but it appears that the water flow may have actually stopped altogether, with significant stretches of the channel apparently dry or covered with surface vegetation or loose debris. As illustrated in the time series below with Figures 2-4, the channel on 7 June maintained an unbroken flow of water, although with a clear narrowing of the channel width from a maximum of 14 meters on 22

Figure 2 - Reduced water flow through the channel as on 7 June 2011

Figure 3 - Continued reduction in observed channel water flow as on 28 August 2011

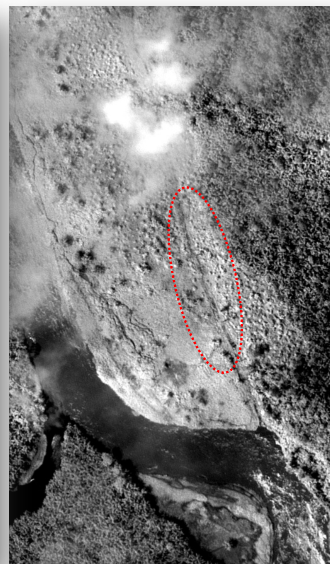


Figure 4 - Possible interruption of water flow through the channel as on 17 October 2011

[3] *The 'Soberania' was apparently moved south (upstream) between 7 June and 28 September 2011.*
[4] *Likely constructed between 8 August and 19 November 2010*
[5] *UNITAR/UNOSAT Update Report:3 of 13 September 2011, see also Reports completed 4 January, 10 February and 3 March 2011*

February to only 3 meters (see Figure 2) as on 7 June 2011. In Figure 3, the channel had a noticeable reduction in width and apparent water flow, with a section approximately 150m long (circled in red) that possibly was dry; while in Figure 4, the channel as on 17 October 2011 appeared to be non-functioning with little or no visible indications of water flow from the San Juan river to Laguna Los Portillos.

Although there is some level of relative uncertainly regarding the exact presence and extent of water flow through the channel because of variations in the spectral and spatial resolutions of the available satellite imagery, there is nevertheless a highly probable observed trend of falling water flow through this channel over the course of the last six to eight months, likely due to the continued accumulation of fluvial sediments including those from bank erosion as well as the lack of maintenance dredging.

A review of vegetation cover changes in the immediate vicinity of the channel between the San Juan and Laguna Los Portillos indicated no significant instances of deforestation or other measurable areas of vegetation cover removal between 7 June and 25 October 2011.

ANALYSIS SECTION 3: REVIEW OF MEANDER CUT SITES (MAPS 5-6)

The major cut site in the meander bend along in the San Juan River immediately upstream from the new channel area[6] as identified and described in detail in the earlier UNITAR/UNOSAT reports has remained relatively unchanged between 7 June and 25 October 2011, showing no indications of significant erosion along the river banks or changes in water flow due to deposition or further dredging. There is, however, a possible light to moderate accumulation of sediment deposits along the inner edge of the original river bend, however this may be only due to normal fluctuations in the river levels. See Figures 5 and 6 below and see also focus Map 5 on page 9. Further, there are no indications within the immediate vicinity of meander cut site 1 of deforestation or other measurable changes in vegetation cover over the same period. There has been recent building activity within the area, specifically the construction of two small structures approximately 5x5m in size on the Nicaraguan side of the San Juan immediately adjacent to the meander bend cut.

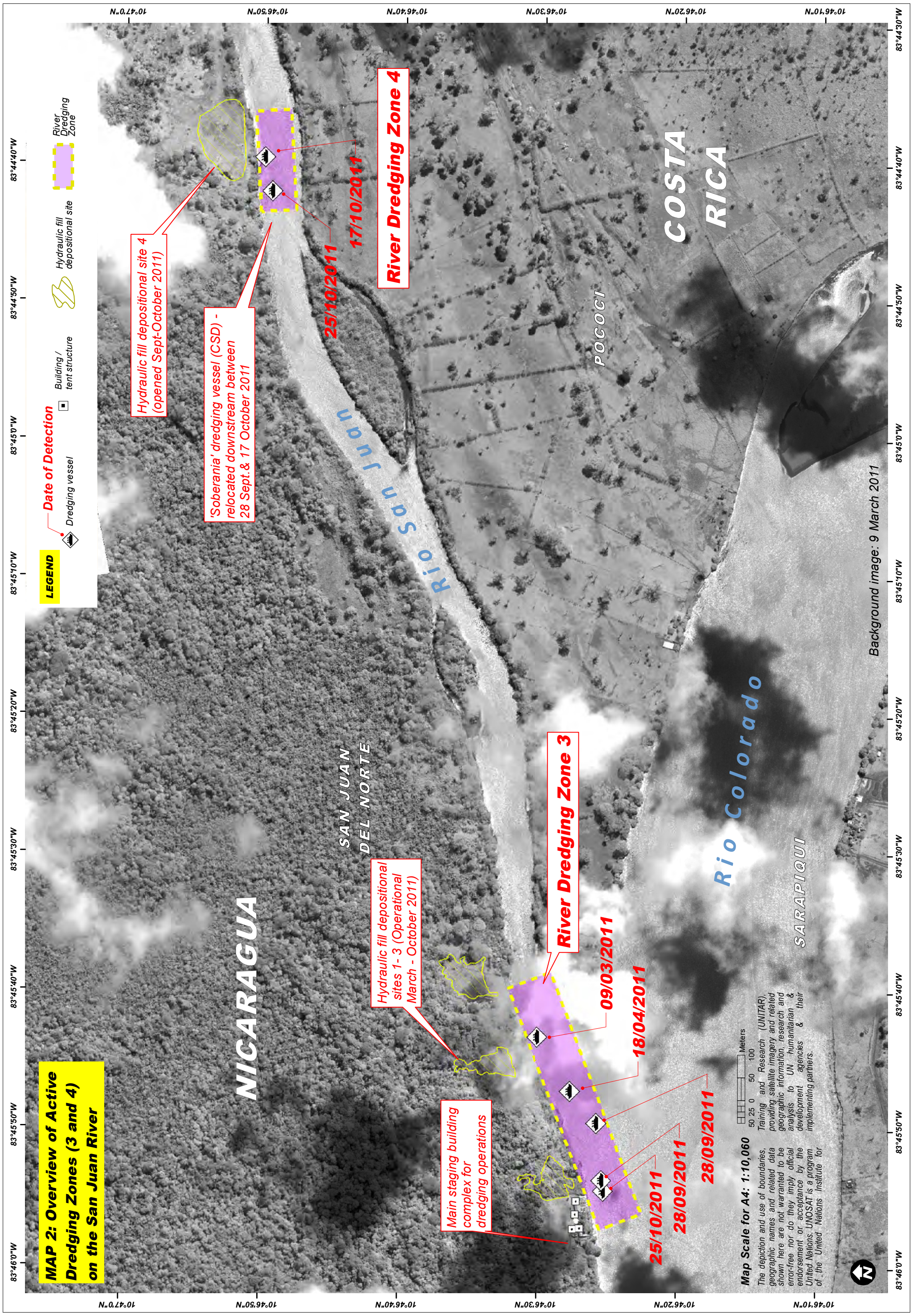
Figure 5 - Meander Cut Site 1 on 7 June 2011

Figure 6 - Meander Cut Site 1 on 17 October 2011

A review of the possible second meander cut site 2 also indicated no further activity in either river dredging or vegetation cover removal between 7 June and 17 October 2011. As illustrated in Map 6 on page 10, the small creek likely originating from Laguna la Barca in Nicaragua has remained stable but slightly diminished in water flow, while the area of significant tree cover removal identified between 24 January and 22 February 2011, has also remained unchanged with no indication of further changes, suggesting that the possible plan for a second meander cut along the San Juan in this area had been suspended between 22 February and 7 June 2011.

Contact Information:
Please send additions / corrections to
UNITAR / UNOSAT:
unosat@unitar.org
Palais des Nations,
Geneva, Switzerland
T: +41 22 767 4020
24/7 hotline: +41 76 487 4998
www.unitar.org/unosat

[6] *Initiated with the Nicaraguan dredging vessel 'Soberania' in November 2010 and successfully completed by 22 February 2011*


MAP 2: Overview of Active Dredging Zones (3 and 4) on the San Juan River
LEGEND
Date of Detection
Dredging vessel
Building / tent structure
Hydraulic fill depositional site
River Dredging Zone
NICARAGUA
SAN JUAN DEL NORTE
COSTA RICA
POCOCI
SARAPIQUI
Rio San Juan
Rio Colorado
River Dredging Zone 4
17/10/2011
25/10/2011
Hydraulic fill depositional site 4 (opened Sept-October 2011)
'Soberania' dredging vessel (CSD) - relocated downstream between 28 Sept.& 17 October 2011
River Dredging Zone 3
09/03/2011
18/04/2011
28/09/2011
28/09/2011
25/10/2011
Hydraulic fill depositional sites 1- 3 (Operational March - October 2011)
Main staging building complex for dredging operations
Background image: 9 March 2011
Map Scale for A4: 1:10,060
Meters
50 25 0 50 100
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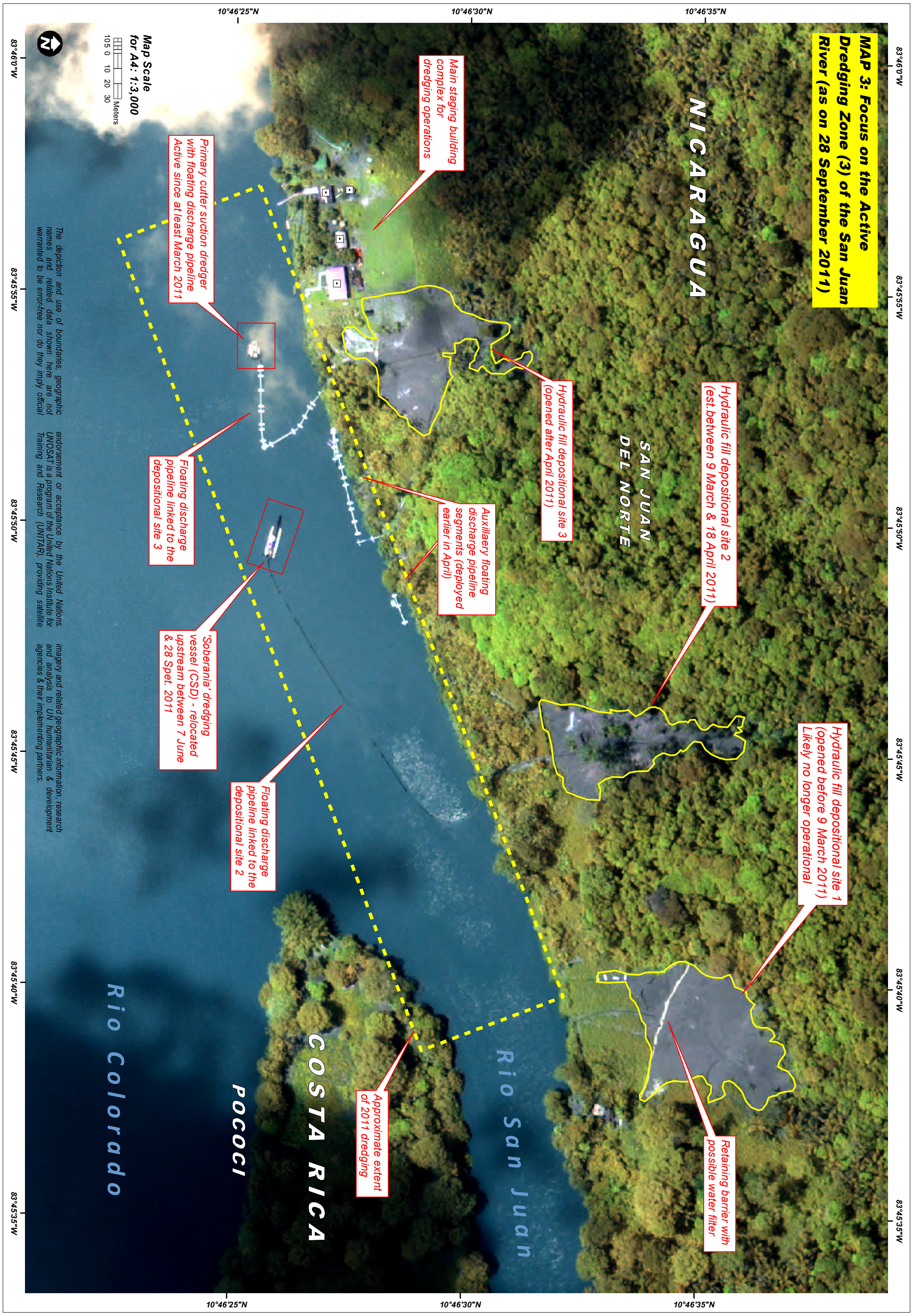
MAP 3: Focus on the Active Dredging Zone (3) of the San Juan River (as on 28 September 2011)
NICARAGUA
SAN JUAN DEL NORTE
COSTA RICA
POCOCI
Rio San Juan
Rio Colorado
Main staging building complex for dredging operations
Hydraulic fill depositional site 3 (opened after April 2011)
Hydraulic fill depositional site 2 (est.between 9 March & 18 April 2011)
Hydraulic fill depositional site 1 (opened before 9 March 2011) Likely no longer operational
Retaining barrier with possible water filter
Primary cutter suction dredger with floating discharge pipeline Active since at least March 2011
Floating discharge pipeline linked to the depositional site 3
Auxillary floating discharge pipeline segments (deployed earlier in April)
'Soberania' dredging vessel (CSD) - relocated upstream between 7 June & 28 Spet. 2011
Floating discharge pipeline linked to the depositional site 2
Approximate extent of 2011 dredging
Map Scale for A4: 1:3,000
10 5 0 10 20 30 Meters
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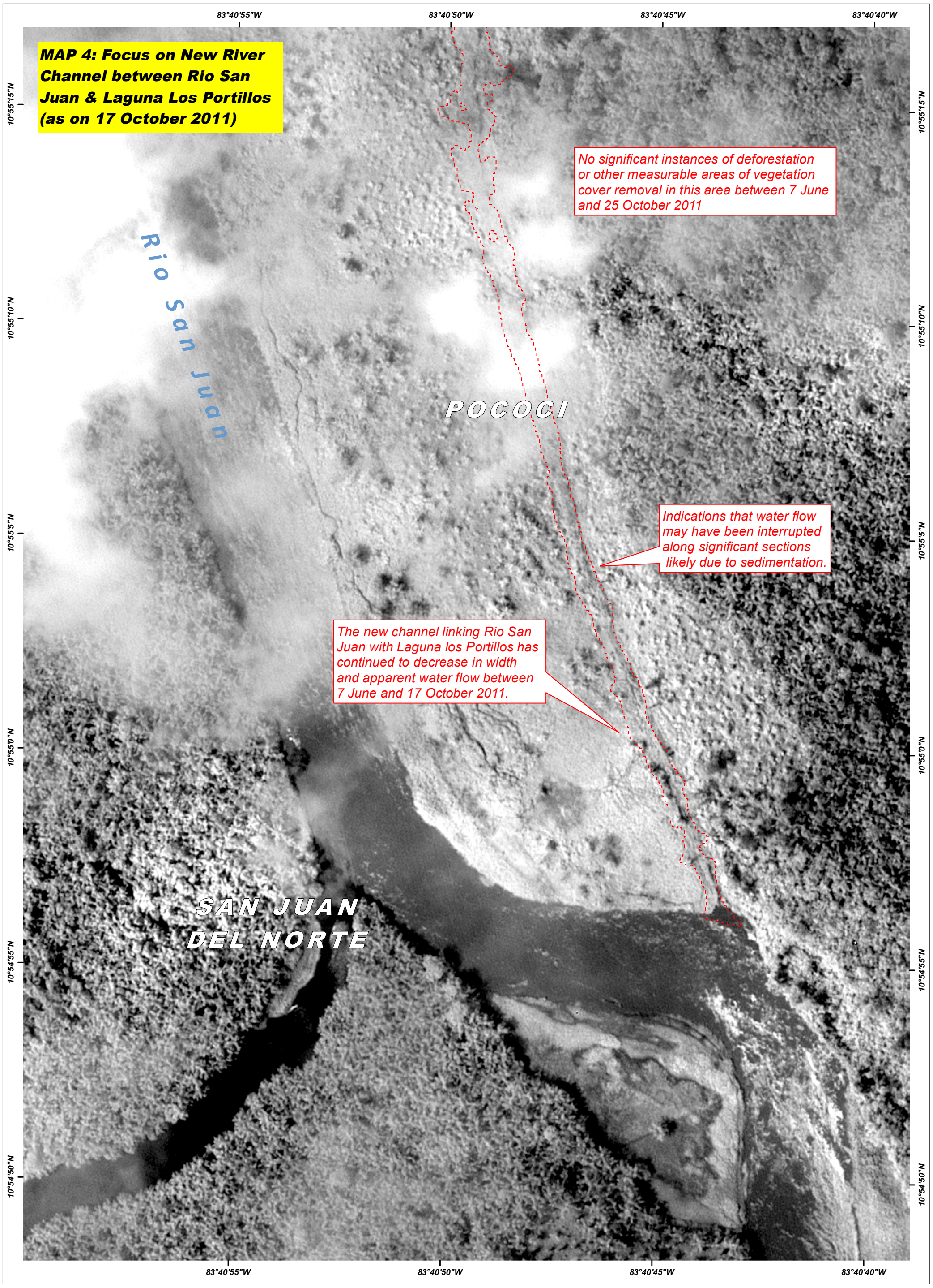
10°46'25"N
10°46'30"N
10°46'35"N
83°46'0"W
83°45'55"W
83°45'50"W
83°45'45"W
83°45'40"W
83°45'35"W



Map Scale for A4: 1:3,400

20 10 0 20 40 60 80 Meters

Background satellite image 17 October 2011

New river channel water extent as on 19 Nov. 2010

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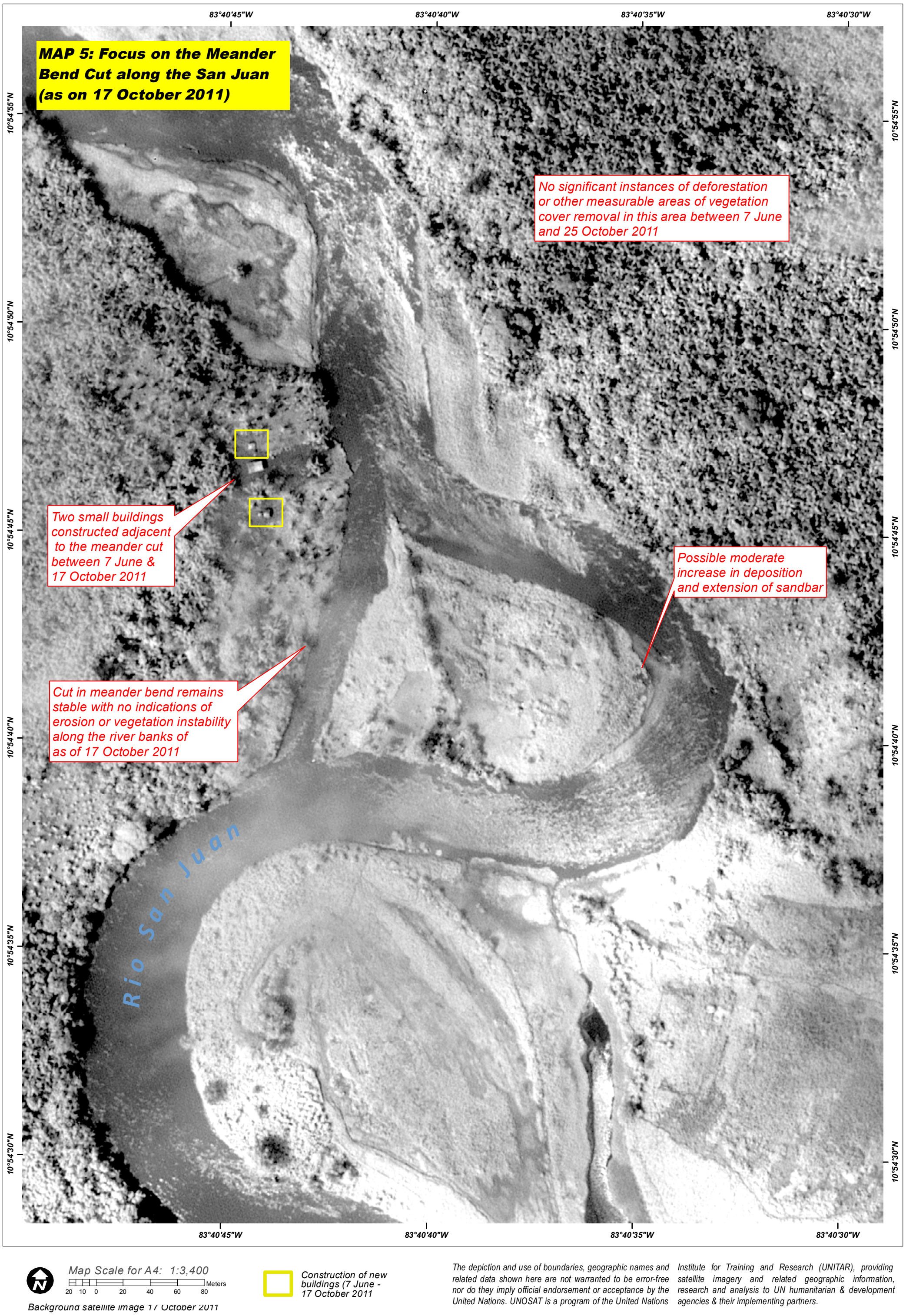
MAP 5: Focus on the Meander Bend Cut along the San Juan (as on 17 October 2011)
No significant instances of deforestation or other measurable areas of vegetation cover removal in this area between 7 June and 25 October 2011
Two small buildings constructed adjacent to the meander cut between 7 June & 17 October 2011
Possible moderate increase in deposition and extension of sandbar
Cut in meander bend remains stable with no indications of erosion or vegetation instability along the river banks of as of 17 October 2011
Río San Juan
83°40'45"W
83°40'40"W
83°40'35"W
83°40'30"W
10°54'55"N
10°54'50"N
10°54'45"N
10°54'40"N
10°54'35"N
10°54'30"N
Map Scale for A4: 1:3,400
20 10 0 20 40 60 80 Meters
Construction of new buildings (7 June - 17 October 2011
Background satellite image 17 October 2011
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unitar

United Nations Institute for Training and Research

UNOSAT

UNITAR / UNOSAT
unosat@unitar.org
Palais des Nations,
Geneva, Switzerland
T: +41 22 767 4020 (Operations)
24/7 hotline: +41 76 487 4998
www.unitar.org/unosat

Annex 151

Minutes of the Coordination Meeting, Technical Advisory Mission of the Secretariat of the Ramsar Convention and Representatives of the Ministry for the Environment, Energy and Telecommunications

4 April 2011

MINUTES

COORDINATION MEETING

TECHNICAL ADVISORY MISSION OF THE SECRETARIAT OF THE RAMSAR CONVENTION AND OFFICIALS OF THE MINISTRY OF THE ENVIRONMENT, ENERGY AND TELECOMMUNICATIONS

San Jose, 4 April, 2011

1. The officials of the Costa Rican Ministry of The Environment, Energy and Telecommunications welcome the members of the Technical Advisory Mission of the Secretariat of the Ramsar Convention.

2. Both delegations agree that this mission is in the context of and to comply with the second provisional measure issued by the International Court of Justice on 8 March, 2011, the purpose of which is to take the necessary actions to avoid irreparable damage to the wetlands identified by the Court in its Order.

3. Both Delegations agree that this visit is the result of consultations made by the Government of Costa Rica and transmitted to the Secretariat of the Ramsar Convention relating to the implementation of all actions necessary to avoid irreparable damage to the wetlands identified by the Court.

4. In keeping with this coordination, this technical mission aimed at an on-site visit has been scheduled in order to determine the situation of the wetland and thereby establish, as appropriate, the actions necessary to avoid irreparable damage to the wetlands in question.

5. Among the actions agreed upon are to send to the area indicated by the Court in paragraph 86 of the Order, only the technical teams including, on one hand, the members of the Technical Advisory Mission of the Secretariat of the Ramsar

Convention, and, on the other hand, the Costa Rican civilian technicians responsible for the protection of the environment.

6. Once at the site, they will proceed to collect technical and scientific information to establish the current conditions of the wetland, and thereby determine the appropriateness of implementing monitoring actions and/or restoration that is to be reflected in a short, medium and long-term work plan, in order to avoid irreparable damage. This plan will be coordinated with the Secretariat of the Ramsar Convention and the Costa Rican civilian technicians in charge of environmental protection.

7. Once the actions on site are completed, both parties shall reconvene a meeting to establish the next steps within the framework of the Order issued on 8 March 2011 by the International Court of Justice.

8. The meeting is adjourned at 13:00 on 4 April 2011.

For the Technical Advisory Mission For the Ministry of the Environment,

of the Ramsar Secretariat Energy and Telecommunications

Annex 152

Minutes of the Coordination Meeting, Technical Advisory Mission of the Secretariat of the Ramsar Convention and Representatives of the Ministry for the Environment, Energy and Telecommunications

7 April 2011

MINUTES

COORDINATION MEETING

TECHNICAL ADVISORY MISSION OF THE SECRETARIAT OF THE RAMSAR CONVENTION AND OFFICIALS OF THE MINISTRY OF THE ENVIRONMENT, ENERGY AND TELECOMMUNICATIONS

San Jose, 7 April 2011

1. In compliance with that agreed during the meeting on 4 April 2011, the delegation comprising members of the Technical Advisory Mission of the Secretariat of the Ramsar Convention and Costa Rican civilian technicians in charge of environmental protection who are members of the Commission set up for this purpose by the Costa Rican Ministry of the Environment, Energy and Telecommunications, went on 5 and 6 April 2011 to the area indicated by the International Court of Justice in its Order of 8 March 2011, to determine *in situ* the situation of the wetland and thereby establish, as appropriate, the actions needed to avoid irreparable damage to the area indicated by the Court.

2. Those who participated in the mission acknowledged the valuable technical work carried out at the site on 5 April, which enabled them to collect the necessary technical input to determine the current condition of the wetland. Also, although a second trip was scheduled for 6 April to supplement certain technical data and perform a targeted flyby of the area, due to a lack of security for guaranteeing the safety of the experts, resulting from actions beyond the control of the Costa Rican Government, it was decided that they would not enter the area and use the flyby option instead to complement the information.

3. Following the mission, today the members of the mission of the Secretariat of the Ramsar Convention met with the Costa Rican civilian technicians to assess and integrate the technical information collected, in order to establish a work plan that

includes management actions, monitoring and/or restoration needed to avoid irreparable environmental damage to the wetland.

4. Both delegations agreed on the importance of joint actions with Nicaragua for the comprehensive management of the wetland.

5. It was also agreed that based on data collected, the Costa Rican technicians would, in a timely manner, prepare a report and work plan to be submitted for consultation to the Ramsar Convention Secretariat, as established by the order issued by the International Court of Justice .

6. The meeting adjourned at 18:00 on 7 April 2011.

For the Technical Advisory Mission For the Ministry of the Environment,

of the Ramsar Secretariat Energy and Telecommunications

Annex 153

Fallas, Jorge, "Sketch map of the 1898 boundary line between Costa Rica and Nicaragua in the San Juan River area and its accordance with the official cartography of Costa Rica (CRTM05) of 2010" National University of Costa Rica, School of Environmental Sciences, Ambientico, 2011.

Available at:
http://www.edeca.una.ac.cr/files/jfallas56/2011/levantaminto1898_carto2010CR_jfallas2011(1).pdf

5 August 2011

Sketch map of the 1898 boundary line between Costa Rica and Nicaragua in the San Juan River area and its accordance with the official cartography of Costa Rica (CRTM05) of 2010

Jorge Fallas

GEOAMBIENTE

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2011

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School of Environmental Sciences http://www.edeca.una.ac.cr/
http://www.edeca.una.ac.cr/index.php/educacion/gm
Faculty of Earth and Ocean Sciences http://www.tierraymar.una.ac.cr/
National University http://www.una.ac.cr/
Heredia, Costa Rica
Telephone (506) 277 3290 • Fax (506) 277 32

Summary

In October 2010 a new dispute arose between Costa Rica and Nicaragua concerning the temporary occupation and illegal use by Nicaragua of a portion of Costa Rican territory. Civilian and military personnel authorized by the government of Nicaragua invaded Costa Rican territory as part of the "reopening/cleaning" of an alleged "old caño" that, according to Nicaraguan authorities, is located between the Aragón farm (Costa Rica) and the Los Portillos lagoon (Nicaraguan territory known as Harbor Head), situated on the island of the same name, which according to Nicaragua constitutes the "real boundary" between the two countries. This paper addresses the issue of the alleged territorial dispute and it aims to provide cartographical evidence to demonstrate that there is no such dispute; the boundary between the two countries is expressly described in the 1858 Cañas-Jerez Treaty of Territorial Limits between Costa Rica and Nicaragua, the 1888 Cleveland Award and the 1897 Alexander Award.

Both the text of the treaty and of the Awards describe with precision the location of the boundary line between Costa Rica and Nicaragua using geographical features that existed at the relevant time and that, as demonstrated in this study, have not changed substantially to justify the new boundary line adopted by Nicaragua. The survey of the boundary line made in 1898 is summarized in a table that contains the station name, the observation points, horizontal angles, azimuths, distance (m), partial coordinates (x, y) and total coordinates (x, y). Act X of 2 March 1898, in describing the survey data on page 31, reads "***Survey of the right margin of the Harbor Head lagoon and of the San Juan River, which constitutes the dividing line between Costa Rica and Nicaragua***" (emphasis added). It should be noted that for umpire Alexander, the mapped course describes in a numerical manner the boundary between Costa Rica and Nicaragua as he literally described it in his First Award of 1897.

By converting the log entries that describes the location of the boundary line sketched in 1898 (Acta X, pp. 29-37) following the CRTM05 system, employed in the official cartography of Costa Rica in 2010, it is clear that the boundary line has not changed significantly over the course of the last 110 years. This evidence contradicts the argument made by Nicaragua, which can be summarized in the position adopted by Carlos Argüello (2011)… "*When we began the dredging works, announced five years ago, the environmental impact of which has been documented, we realized that our maps, that have not been revised for 100 years – all our maps stipulate that they have not been verified on the ground – and in light of the Alexander Award, that the border cannot be where Costa Rica claims it to be, because it would contradict the mentioned award.*" Evidence presented in this study supports the position of Costa Rica and it undermines Argüello's claims. In short, there is no boundary dispute, but rather a unilateral decision by Nicaragua to modify the boundary line.

Introduction

In October 2010 a new dispute arose between Costa Rica and Nicaragua concerning the temporary occupation and illegal use by Nicaragua of a portion of Costa Rican territory (International Court of Justice 2010, Government of Costa Rica 2010). Civilian and military personnel authorized by the government of Nicaragua invaded Costa Rican territory in order to "reopen/clean" a supposedly "old caño" that according to Nicaraguan authorities was located between the Aragón farm (Costa Rica) and the Los Portillos lagoon (Nicaraguan territory known as Harbor Head), situated on the island of the same name, and which according to Nicaragua constitutes the "real boundary" between the two countries (Fig. 1) (Argüello 2011, Council of State powers and institutions of constitutional origin of the Republic of Nicaragua 2010). This document addresses the issue of the alleged territorial dispute and it aims to provide cartographical evidence to demonstrate that there is no such dispute; the boundary between the two countries is expressly described in the Cañas-Jerez treaty (1858 Treaty of Territorial Limits between Costa Rica and Nicaragua), the 1888 Cleveland Award (Cleveland 1888) and the Award of E. P. Alexander of 1897 (United Nations 2007a and 2007b).

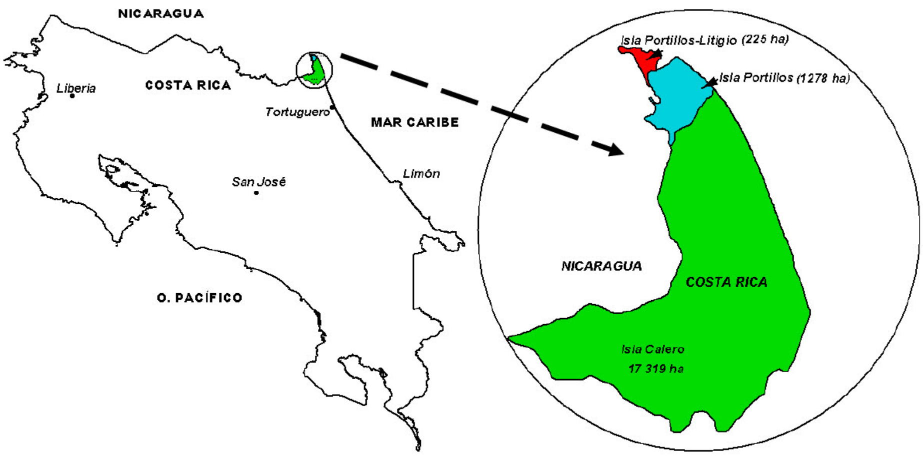


Figure 1: The disputed area in its local and regional context. Note that the disputed area is a segment of approximately 225 ha of Portillos Island.

Treaty of Territorial Limits of 1858, awards and official cartography until October 2010

The boundary between Costa Rica and Nicaragua, agreed to by both countries until 2010, is based on the Cañas-Jerez Treaty (1858 Treaty of Territorial Limits between Costa Rica and Nicaragua), the Cleveland Award of 1888 (Cleveland, 1888) and E. P. Alexander, 1897 (United Nations, 2007a and 2007b).

Cañas-Jerez Treaty of 1858

"The dividing line between the two Republics, starting from the Northern Sea (*Caribbean Sea, clarification of the author*), shall begin at the end of Punta de Castilla, at the mouth of the San Juan de Nicaragua river, and shall run along the right bank of the said river up to a point three English miles distant from Castillo Viejo, said distance to be measured between the exterior works of said castle and the above-named point." Art.2 of the Cañas-Jerez treaty of 1858. (Treaty of territorial limits between Costa Rica and Nicaragua, 1858).

Cleveland Award of 1888

"The boundary line between the Republics of Costa Rica and Nicaragua, on the Atlantic side, begins at the extremity of Punta de Castilla at the mouth of the San Juan de Nicaragua River, as they both existed on the 15th day of April 1858. The ownership of any accretion to said Punta de Castilla is to be governed by the laws applicable to that subject." Art. 3: Pt. 1 of the Cleveland Award (22-3-1888).

The Matus-Pacheco Convention of 1896

This convention, signed on 27 March 1896, describes how to proceed with tracing the boundary line between Costa Rica and Nicaragua (United Nations 2007c). For this purpose, each State appointed a commission of engineers and surveyors who, following the provisions of the 1858 Treaty and the 1888 Cleveland Award, traced and marked out the boundary line. As an arbiter appointed by the President of the United States of America, the engineer E. P. Alexander was empowered to decide on the disputed views of the parties. The following quotations are the relevant articles of this Convention for the purposes of this study:

> Article 1: "The contracting Governments bind themselves to each name a commission composed of two engineers or surveyors for the purpose of properly tracing and marking the boundary line between the Republics of Costa Rica and Nicaragua pursuant to the provisions of the treaty of April 15, 1858, and the arbitration award of the President of the United States of America, Mr. Grover Cleveland."
>
> Article II: "The commissions created by the foregoing article shall be completed by an engineer whose appointment shall be requested by both parties of the President of the United States of America, and whose duties shall be limited to the following: Whenever in the carrying out of the operations the commissions of Costa Rica and Nicaragua shall disagree, the disputed point or points shall be submitted to the judgment of the engineer named by the President of the United Sates of America. The engineer shall have ample authority to decide any kind of dispute that may arise, and his decision shall be final as to the operations in question."
>
> Article V: "The contracting parties stipulate that if from any cause either the commission of the Republic of Costa Rica or that of Nicaragua should fail to appear at the place designated, on the day named at the beginning of the work, this shall be begun by the commission that may be on hand, the engineer of the United States Government being present, and whatever may be so done shall be valid and final in so far as regards the Republic failing to send its commissioners. The same course shall be pursued should any or all of the commissioners of either of the contracting Republics absent themselves after the beginning of the work, or should they refuse to carry out

the same in the manner laid down in the award and treaty herein referred to, or in accordance with the decision of the engineer appointed by the President of the United States."

Article VII: "In case of the temporary suspension of the work of demarcation whatever may be done up to the time of suspension shall be held as final and conclusive, and the boundaries in the respective parties shall be deemed as materially established, even though owing to unexpected and insuperable circumstances such suspension should continue indefinitely."

Article VIII: "The minutes of the work, which shall be kept in triplicate and which the commissioners shall duly sign and seal, shall constitute, without the necessity of approval or any other formality on the parts of the signatory Republics, the proof of the final demarcation of their boundaries."

In his role as arbiter, Alexander issued five awards or resolutions between 1897 and 1900 on various aspects disputed by Costa Rica and Nicaragua. Of these five awards, the first and second are key to the present analysis and therefore they are discussed in greater detail in the following sections.

First Award of E. P. Alexander of 1897

In his first Award, Alexander described the boundary line between Costa Rica and Nicaragua as follows: "Its direction shall be due northeast and southwest, across the bank of sand, from the Caribbean Sea into the waters of Harbor Head Lagoon (*called Portillos Lagoon in Costa Rican cartography, clarification of the author*). …. On reaching the waters of Harbor Head Lagoon, the boundary line shall turn to the left, or southeastward, and shall follows the water's edge around the harbor until it reaches the river proper by the first channel met. Up this channel, and up the river proper, the line shall continue to ascend as directed in the treaty". Award E. P. Alexander of 30 September 1897. (United Nations 2007a).

The official cartography of Costa Rica and Nicaragua that existed prior to the present dispute is based on the texts of the Treaty of Territorial Limits of 1858, the abovementioned Awards, and the joint work of the technical teams of both countries (Lobo 2010). Until October 2010, both the Nicaraguan Institute of Territorial Studies (INETER-NIC) and the National Geographic Institute of Costa Rica (IGN-CR) had accepted the boundaries reflected in the official maps of both countries (Fig. 2) as a valid visual representation and chart of the treaties and awards. However, without prior notice to the government of Costa Rica, Nicaragua decided to ignore such boundaries and upon commencing the dredging of the San Juan River it argued that it had "discovered" that the boundary "was wrong" (Argüello, 2011); thereby unilaterally modifying the previously established boundary as demonstrated in Figure 2. The arguments relied upon by the political and technical authorities of Nicaragua to justify the unilateral modification of the border include that the maps were not verified on the ground, that the course of the San Juan River has changed over the last 110 years, and that the "caño" cleaned by Pastora was referred to by Alexander in his First Award (Argüello, op.cit.).

Both the text of the treaty and the awards describe the precise location of the boundary line between Costa Rica and Nicaragua using geographical features that existed at the relevant time and which, as this study demonstrates, have not substantially changed to justify the retracing of the border adopted by Nicaragua. These documents, and the first two Alexander Awards in particular, clearly express the will of the parties as to the geographic location of the boundary line in the area located between Castillo Viejo and the mouth of San Juan de Nicaragua river and any unilateral change to these boundaries is a violation of the official demarcation previously accepted by both countries.

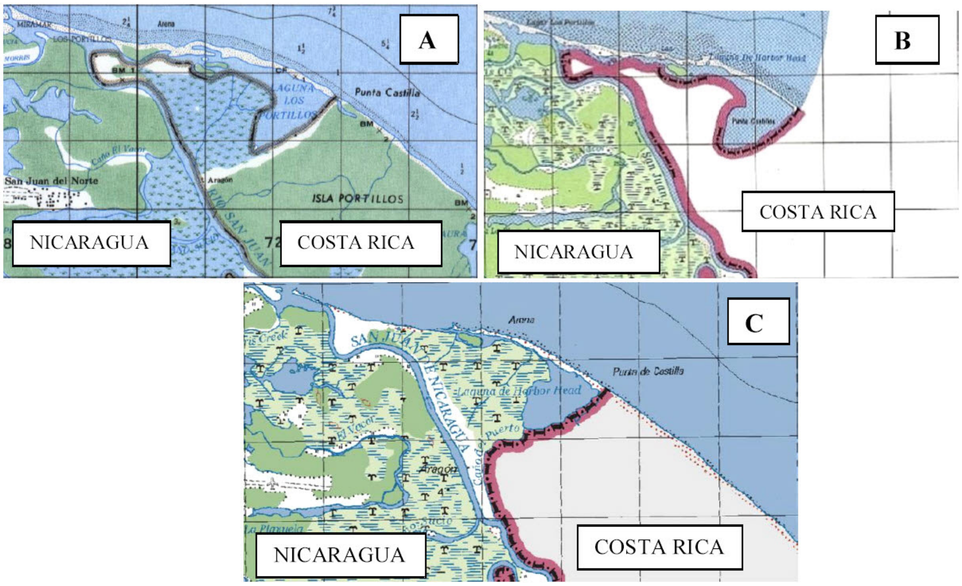


Figure 2: Boundaries accepted by Costa Rica (A) and Nicaragua (B) until the year 2010 and the new boundary unilaterally drawn by Nicaragua in 2011 (C).

Alexander Proceedings and the boundary line between Costa Rica and Nicaragua in 1898

As mentioned, the Cleveland Award of 1888 and the first Alexander award of 1897 indicated in literal terms where the boundary began and its perimeter in the disputed area; however, in the opinion of the Costa Rican authorities in 1897, it was necessary to undertake a ground survey ("digital demarcation") that would allow Costa Rica to determine in the future the location of the boundary line when Alexander issued his first award in 1897.

For this reason, on 30 June 1897, the Costa Rican commission requested Alexander to proceed with "measuring the line from its origins, then coastwise by Harbor Head, bordering the nearest stream to San Juan River and following the course to a point three miles downstream from Castillo Viejo: that the line be drawn, and the day-to-day operations be registered in minutes of the meetings" (p. 14, Proceedings VII of 30 June 1897). For its part, the Nicaraguan delegation expressed "their objection to what they termed as useless work insofar as the Treaty and General E. P. Alexander's decision established the dividing line at the edge of the Harbor and the River, and that their alternative would be a variable rather than a fixed line, and that resulting data would not yield a true dividing line." (p. 14, Proceedings VII of 30 June 1897).

For his part, Alexander argued that "The proposed measurement and demarcation of the boundary line will not have any effect on the application of those principles (*referring to the previously mentioned Treaty and the Awards, author's comment*). The fact that the line has been measured and demarcated will neither increase nor decrease any legal standing that it might have had it not been measured or demarcated. The only effect obtained from measurement and demarcation is that the nature and extent of future changes may be easier to determine. There is no denying the fact that there is a certain contingent advantage to being always able to locate the original line in future… Costa Rica wants to have that future capacity. Nicaragua feels that the contingent benefit is not worth the current expenditure. In order to decide which one of these views should hold sway, I have to abide by the spirit of the letter of the 1858 Treaty and to determine whether there is anything in either point of view that is applicable to the question."

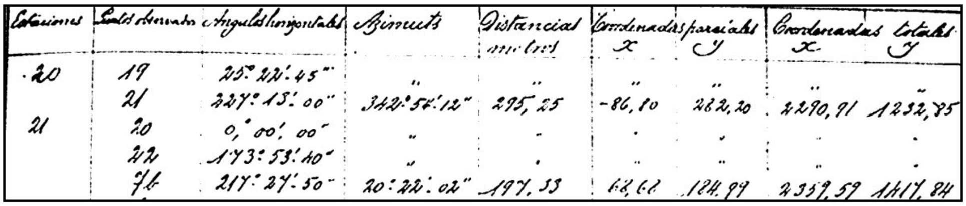
According to Alexander, Costa Rica's request was supported by the text of article 3 of the 1858 Treaty, which provides that "measurements corresponding to this dividing line (*described in article 3*) shall be taken in whole or in part by the Government commissioners, who shall agree on the time required for such measurements to be made. The commissioners shall be empowered to diverge slightly from the curve around El Castillo, from the line parallel to the banks of the river and lake, or from the straight astronomical line between Sapoá and Salinas, provided that they can agree upon this, in order to adopt natural landmarks." It should be noted that at this moment in time there was no difficulty envisaged with regards to locating the right bank of the San Juan river or Harbor Head, which mark the boundary between Costa Rica and Nicaragua.

Finally, Alexander held as follows: "I therefore announce my award as follows: the Commissioners shall immediately proceed to measuring the line from the starting point to a point three miles below El Castillo Viejo, as proposed by Costa Rica". E.P. Alexander, Engineer arbiter. Alexander Award No.2, 20 December 1897. (United Nations 2007b).

Act X on page 31 reads: "...in compliance with the Award issued by the Engineer Arbiter on December the 20th of 1897, the boundary line was measured as described in the Award of September 30th of 1897, starting from the initial marker, following around the Harbour and through the first channel met up to the river proper, and through this until pole No. 40 next to the source of the Taura River." (Proceedings X, p. 31).

Survey of the perimeter in 1898

The survey conducted in 1898 is summarized in a table that contains the station name, the observation points, horizontal angles, azimuths, distance (m), partial coordinates (x, y) and total coordinates (x, y) (Boundary Delimitation Commission, Costa Rica-Nicaragua, 1898) (Fig. 3)., When describing the survey data on p. 31, Proceedings X read "***Survey of the right margin of the Harbor Head lagoon and of the San Juan River, which constitutes the dividing line between Costa Rica and Nicaragua***" (emphasis added). It should be noted that for umpire Alexander, the mapped course describes in a numerical manner the boundary between Costa Rica and Nicaragua as he literally described it in his First Award of 1897 (United Nations 2007a). Any change to the said mapped course without valid support constitutes a violation of the boundary treaty agreed to by Costa Rica and Nicaragua in the 1858 Cañas-Jerez treaty and reaffirmed in the Cleveland Award of 19888, the Matus–Pacheco Convention of 27 March 1896 (setting out the procedure for tracing and measuring the boundary line between the two republics) and the First Award of E. P. Alexander of 1897 (Lobo 2010).



Estaciones	Puntos observados	Angulos horizontales	Azimuts	Distancias metros	Coordenadas parciales X	Y	Coordenadas totales X	Y
20	19	25° 22′ 45″						
	21	227° 13′ 00″	342° 54′ 12″	295,25	-86,10	282,20	2290,91	1232,85
21	20	0° 00′ 00″						
	22	173° 53′ 40″						
	76	217° 27′ 50″	20° 22′ 02″	197,33	68,62	184,99	2359,59	1417,84

Figure 3: Copy of a segment of the transcripts that accompany the Proceedings X of 2 March 1898. The coordinate values express in a two-dimensional table the location of each point of the geodetic survey in the local coordinate system created by the joint commission and approved by Alexander in his capacity as arbiter. Source: Boundary Delimitation Commission, Costa Rica-Nicaragua, 1898.

On pages 27 and 31 of Proceedings X of 2 March 1898, it reads: "... [the delimitation commissions] proceeded first and foremost to emplace the Monument that determined the Initial Point of the dividing line on the Coast of the Caribbean Sea, linking it with the center of Plaza Victoria in San Juan del Norte". The required astronomical observations to determine the azimuths were carried out on 28, 30 and 31 January 1898. The Proceedings indicate that "the aforementioned (marker) monument is 4715-55 (four thousand seven hundred fifteen meters fifty-five centimeters) with a geodetic azimuth of sexagesimal 244^{o} 50′ 23′′ (two hundred forty-four degrees, fifty minutes, twenty-three seconds)". "The coordinates of the Monument or initial marker, taking as origin the center of Plaza Victoria in San Juan del Norte, therefore, are = x = 4268.28 East; y = 2004.54 North; astronomical Meridian" (Proceedings X, p. 31). In order to have another reference point on the opposite side of the lagoon "Harbor Head", the proceedings state that "It was also agreed to have markers emplaced in relation with the first monument, one on the opposite margin of the Harbor Head lagoon, at 1139 meters from the first in a location marked there, with an azimuth of 66^{o} 41′ 05′′; and the other in the aforementioned center of Plaza Victoria in San Juan del Norte" (Proceedings X, p. 31).

Log and corresponding map in 1898

Figure 4 shows the sketch map of the survey conducted by the joint commission of Costa Rica and Nicaragua approved by arbiter Alexander as shown on pages 29 and 33, respectively, of Proceedings X of 2 March 1898. The text of Proceedings X, like the log and the corresponding map, clearly show the location of the perimeter of the Lagoon "Harbor Head" and the location of the right bank of the San Juan river in 1898. From this survey, one may wonder where these elements are situated on the ground in 2010? Have the geographical features referred to by Alexander in March 1898 changed? Is mention made of the "channel" (caño) by Alexander in his first Award? Do the log and the map in

Proceedings X correspond? Is it possible to convert the log entries to the reference system CR05, the 2010 Transverse Mercator projection for Costa Rica (CRTM05) WGS84 ellipsoid?

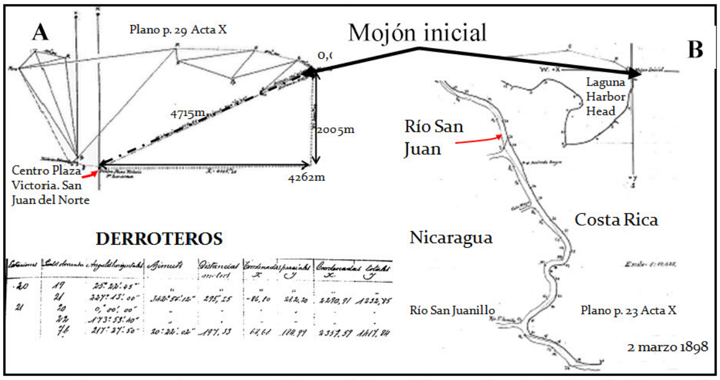


Figure 4: Sketch map drawn and approved by arbiter Alexander in March 1898. At page 29 and B page 33, respectively, of Proceedings X of 2 March 1898. Source: based on the Boundary Delimitation Commission Costa Rica-Nicaragua, 1898.

Conversion of the log entries in Proceedings X to the CRTM05 projection

To respond to the above questions, it is necessary to convert the Cartesian reference system used by the joint delimitation commission in order to determine the location of the right bank of the "Harbor Head" lagoon and the San Juan river (boundary line between Costa Rica and Nicaragua), to the reference system CR05, Transverse Mercator projection for Costa Rica (CRTM05) (Government of Costa Rica, 2007). The sketch map in question corresponds to the log on pages 31 to 37 of the Proceedings X of 2 March 1898 (Boundary delimitation commission Costa Rica-Nicaragua, 1898). This log is graphically represented in the map on page 33 of the same Proceedings. Although it would have been ideal to directly geo-reference the log or the map on page 33, this was not possible because there are not enough control points and, furthermore, by 2010 the Caribbean sea had eroded part of the coastline where the starting point of the border in Punta Castillo (C), the initial marker (I), the principal marker (A) and the first two observation points were sketched by the joint commissions in 1898, as shown in Figure 5. For this reason the process of geo-referencing the map on page 33 was undertaken in three phases, as described below.

Phase 1: Geo-referencing the "US Navy" map prepared for the Commission for the Nicaraguan channel in 1899 (Academy of Geography and History in Nicaragua s.f.). This map is contemporary with the date on which the joint commission undertook measurements in 1898 and it also shows the geographical features that are recognizable in the official cartography of the National Geographic Institute of Costa Rica scale 1:50.000 of 1970 (prepared on the basis of aerial photos of 1961) and the position of the town of San Juan del Norte; key elements for situating the centre of Plaza Victoria. The map of 1899 was geo-referenced to the CRTM05 system using the Punta Castilla map sheet, scale 1:50.000 of the National Geographic Institute of Costa Rica, the programme ArcGIS (www.esri.com) and the linear conversion (*afin*) (Fallas, 2011) (Fig. 6).

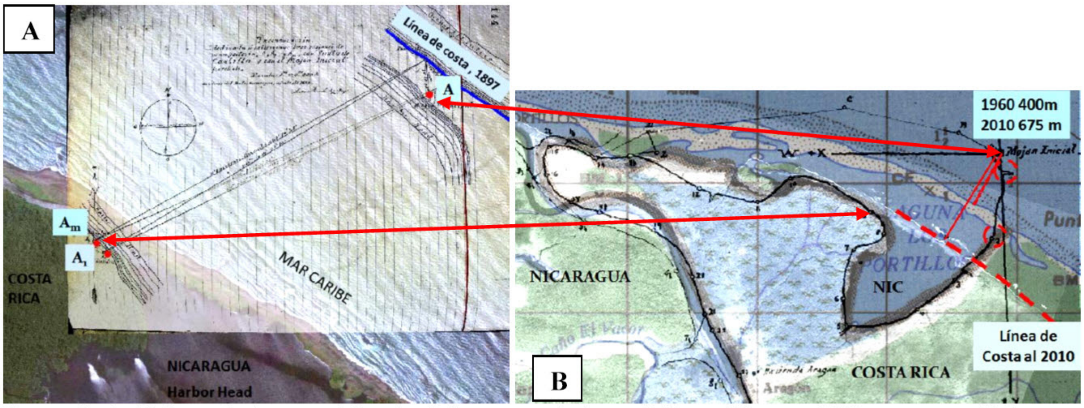
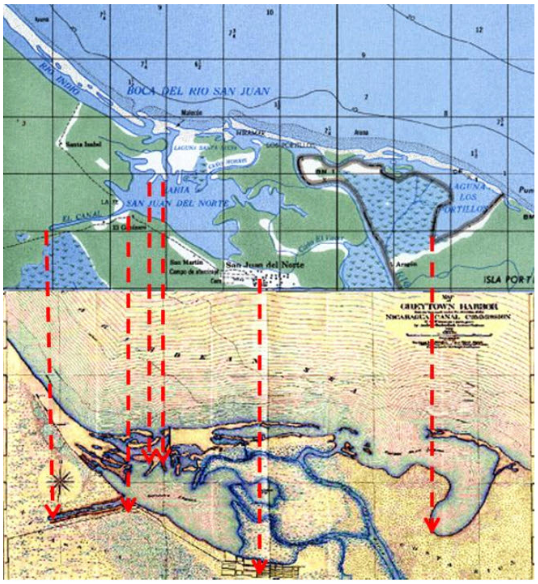


Figure 5: A. Triangulation used by the joint commission of Costa Rica and Nicaragua to link stone markers (A, A_1 y A_m) with "Punta de Castilla" and the initial marker lost in 1899. Source: Map at page 144 of Proceedings XX of 19 August 1899. B. Receding shoreline between 1898 and 2010 (675 m). Note that in 2010 the first two points sketched by the joint commissions in 1898 are situated in the Caribbean sea. The arrows indicate corresponding points in the sketch of 1898 with that of 2010.



Note the similarity between the maps and the aerial photo of 1961.

Figure 6: Control points used to geo-reference the map prepared by the "U.S. Navy" for the Nicaraguan Canal Commission in 1899. One of the advantages of this map is that it shows the geographic features that existed at a time contemporaneous to the sketch approved by arbiter Alexander in 1898.

Phase 2: Geo-referencing the map on page 29 of Proceedings X of 2 March 1898

Even though the map at page 29 (Fig. 7) does not provide any information concerning the location of the boundary between Nicaragua and Costa Rica, it does include one of its reference points in the centre of the Plaza Victoria in San Juan del Norte, as well as the distance between this point and the perpendicular that intercepts the initial marker in "Punta Castilla" (4262,28 m) and the distance of this perpendicular (2004,54 m) to the initial marker. Furthermore, it also has several stations in common with the map on page 33 (initial marker (M), stations B, C, E, P_p and D), which can be used for the purpose of geo-referencing.

Another important aspect of the map is that it indicates the distance and azimuth between Plaza Victoria and the initial marker (4715,55 m, 244,8397^0) and between the initial marker and the other auxiliary marker (A_1) located on the opposite shore of the Harbor Head lagoon (1139 m, 246,6847^0) (Fig. 7). To locate the centre of Plaza Victoria an 'urban' sketch of the map prepared by the "US Navy" for the Nicaraguan Canal Commission in 1899 was used (Academy of Geography and History in Nicaragua. s.f.) previously geo-referenced to the system CRTM05. Once the location of Plaza Victoria had been determined, a line was traced in a south-westerly direction of 4268 m and another at the end of this line in a perpendicular direction of 2004 m. The eastern and northern end of each line was used as control points. As with the map of 1899, ArcGIS (www.esri.com) was used and it was converted to a linear (*afin*) reading to geo-reference the map on page 29 (Dörries, 2004 a,b; Fallas, 2011). The root mean square error for 10 control points was 28 m, with a minimum of 4 m and a maximum of 42 m.

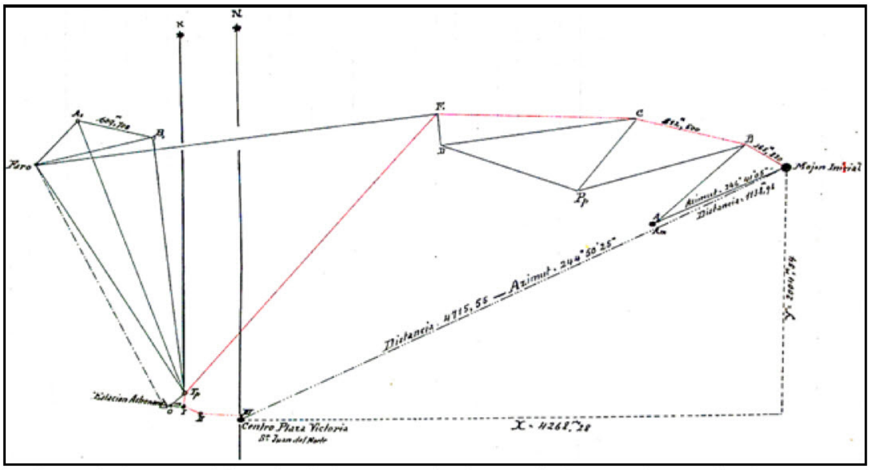


Figure 7: Triangulation used by the joint commissions of Costa Rica and Nicaragua to link the network of stations with the initial marker, the auxiliary markers (A_1 y A_m) and the centre of Plaza Victoria in San Juan del Norte, Nicaragua (III). Map from page 29 of the Proceedings X of 2 March 1898. Source: Boundary delimitation commission Costa Rica-Nicaragua, 1898.

Phase 3: Geo-referencing the map on page 33 of the Proceedings X of 2 March 1898

Once the map on page 29 was geo-referenced, the map on page 33 was then geo-referenced using the points in common that the latter map has with the map on page 29 (initial marker (M), stations B, C, E, P_p y D) as well as other points that can be identified on the map and in the aerial photograph of 1961. In this case, use was also made of ArcGIS and a linear conversion (*afin*) was undertaken to prevent distortion of the geo-referenced map. The mean square error of adjustment was 28 m; this equated to a displacement of 0.56 mm on a map to scale 1:50.000.

Errors in converting the map on page 33 sketched in 1898 to CRTM05

To verify the accuracy of converting the coordinate system of the map on page 33 to CRTM05 the following independent measures were carried out:

1) For 18 segments the distance on the geo-referenced map was calculated and it was compared to the distance measured on the ground in 1898. Figure 8 shows the relationship between the value reported in the Proceedings X for the 18 segments, and the estimated value for each segment once converted to the CRTM05 system. The average error was 13 m (3%), and the maximum was 62 m (5,4%).

2) For 23 points, the converted coordinates were calculated, the differences in the east and north, and the total error (distance between the converted point and the destination), and these were compared with the respective values measured on the ground in 1898. The independent evaluation of the 23 points indicates that the map on page 33 of the Proceedings X was geo-referenced with a mean square error of 85 m; which corresponds to an average displacement of 1,7 mm on a map to scale 1:50.000. The differences in the eastward direction (X) oscillated between 2 and 160 m, while for the northward direction (Y) the values fell within a range of 1 to -31 m (Fig. 9). At first, it may seem that the errors in the east-west direction (X) are larger, however the higher values to 60 m occurred in the lower section of the map and do not affect the quality of the adjustment in the higher section where the area in dispute is located. The increase in error in the east-west direction in the lower part of the map is due to the difficulty to locate control points in this section of the map and because of the changes to the course of the San Juan river in this section.

The results of the evaluation support the conclusion that the conversion of the reference system used in 1898 to the CRTM05 system used in the cartography of Costa Rica in 2010 is reliable and therefore the map of the boundary line traced in 1898 can be superimposed onto maps and photos and recent satellite images in the CRTM05 reference system. These results are consistent with the statements made by Döries (2004b) to the effect that the measurements made by the Alexander Commission remain within certain limits of accuracy in this section of the San Juan River.

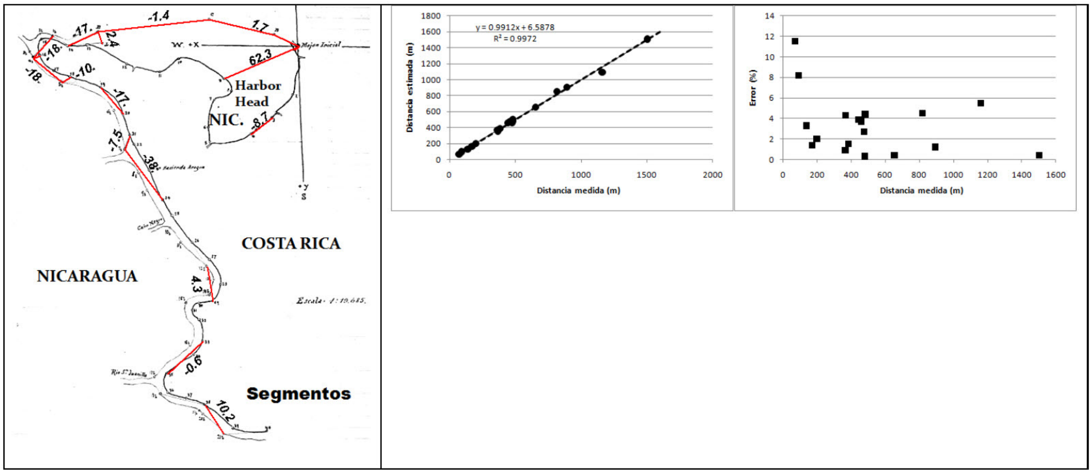


Figure 8: Relationship between the distance reported for 18 segments on the map on page 33 of the Alexander Proceedings X (1898) and the respective estimation using the geo-referenced image in the CRTM05 system.

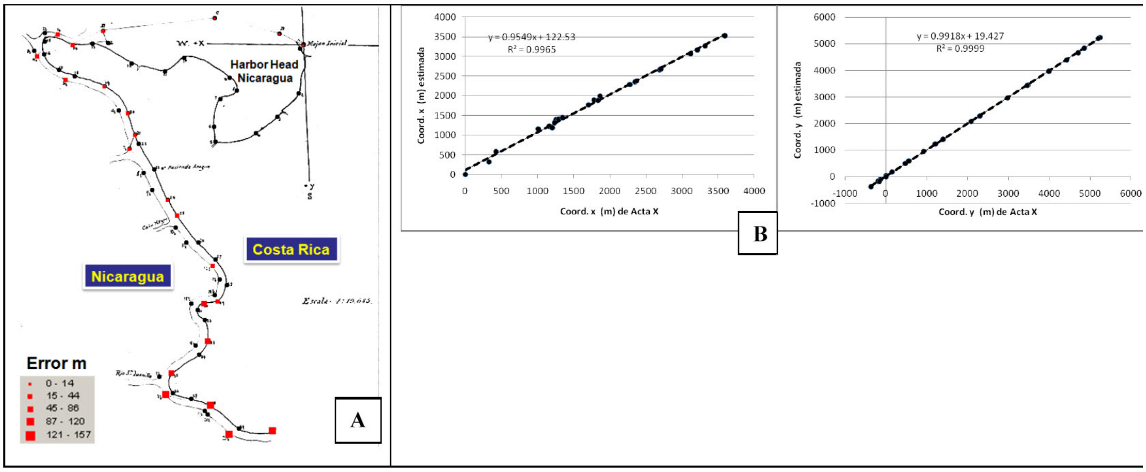


Figure 9: Error in converting the coordinates of the map on page 33 of the Alexander Proceedings X of 1898 to CRTM05. A. Total error (m). B. Relationship between the tabulated coordinates (x, y) that correspond to the map on page 33 of the Alexander Proceedings X, and the respective estimates using the geo-reference map from the CRTM05 system.

Concurrence between the map on p. 33 and the official cartography of Costa Rica and Nicaragua

Once satisfied that the geo-referencing of the map on page 33 of Proceedings X reliably expresses the log approved by the arbiter Alexander in March 1898, a comparison was undertaken between its location and shape, and the official cartography, photos and satellite images available in December 2010.

Figure 10 allows one to appreciate the significant geometric and positional similarity between the sketch map approved by the arbiter Alexander in March 1898 and the 1899 map, with aerial photographs taken in 1961, 1997 and a satellite image from 2010. The evidence makes clear that the changes observed in the right bank of the San Juan river and in the Harbor Head lagoon (Lagoon "Los Portillos") do not justify the position of Nicaragua of ignoring the limits set out in the official maps accepted by Costa Rica and Nicaragua until 2010.

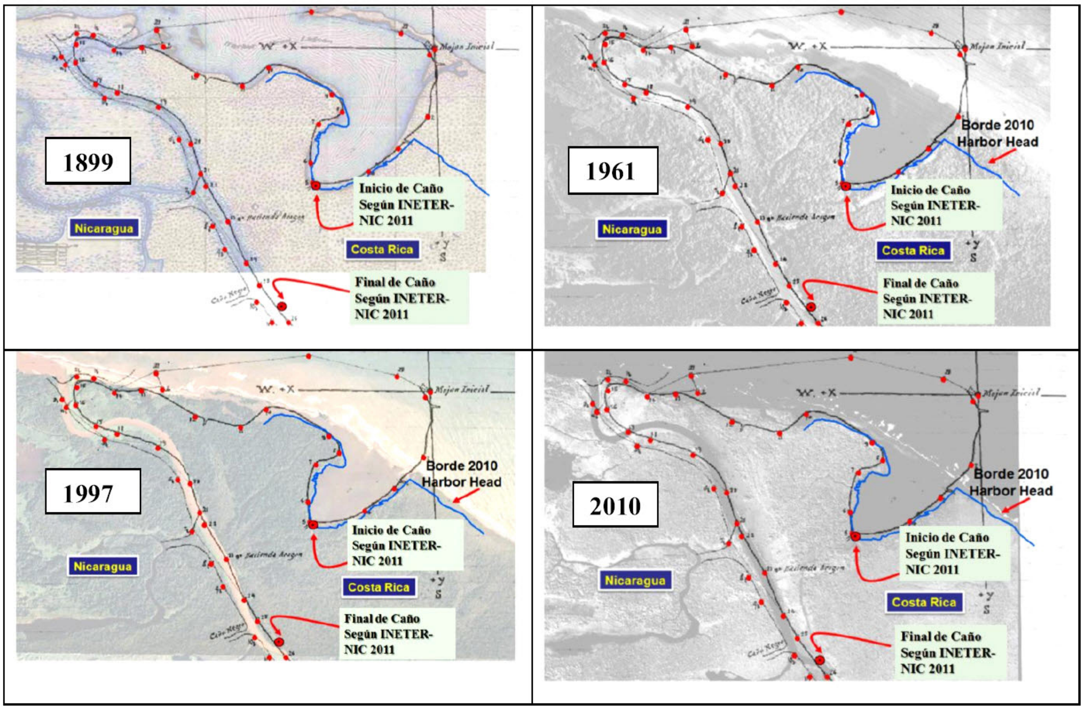


Figure 10: Map on page 33 of the Proceedings X (2 March 1898) and its spatial relation to the map of 1899, the aerial photographs of 1961, 1997 and the satellite image of 2010. The dots indicate the survey approved by Alexander in March 1898. CRTM05 reference system.

In order to test this evidence, what follows is a transcription of the arguments presented by Carlos Argüello, Ambassador of Nicaragua to the Netherlands and the principal Agent of this country before the ICJ, in an interview conducted by Pablo Gámez from Radio "Nederland" on 11 January

2011 (Argüello, 2011). In response to the question "Why do you think that your country is right before the International Court of Justice in The Hague?", Argüello answered:
"The problem was to find the original marker established by Cleveland and the treaty of 1858. He provided the elements to determine these markers. But as the border is a river, thus the border has no markers. The engineer Alexander established markers but the river travels upstream for over one hundred kilometres. From the start of the border, at the mouth of the river and the first marker, there is a distance of approximately 110 kilometres. From there the markers were placed on the ground. Alexander himself notes in the five awards that he issued, in particular in the second and third awards, that it is a border that is subject to change because it must follow changes in the river. When we began the dredging works we realized that our maps, which have not been revised for 110 years – all our maps state that they have not been verified on the ground – and in light of the Alexander award, that the border cannot be where Costa Rica claims it to be, because it would contradict the mentioned award."

And referring to Costa Rica's position concerning the validity of the boundary set out in the official maps, Argüello argued:

"In 1890, the San Juan river from start to finish was divided into two branches. A channel or caño ran to Harbor Head, and the other to the port itself. Alexander stated that it is the channel that runs to Harbor Head. But at the moment the river flows into the sea. The caños that existed have changed and they are not easily identified. In this area there are always caños, because it is a wetland. Following the cleanup work that was begun on the main river, we discovered that the border had changed. This was not work done with dredges, but rather with machetes, shovels and picks that made the narrow path. Nicaragua announced in early December that it had completed this first stage. We can demonstrate with satellite images that this caño always existed, that it was not invented nor did we dig the hole ourselves.... While in the field we discovered that reality was not clear and that it could not be what the Alexander award said it was. Conclusion: we cannot follow the situation as it has stood for 100 years and which has not been verified on the ground."

To illustrate his arguments, Argüello provides the following example taken from the border dispute between Nicaragua and Honduras:

"As an example, the case of Nicaragua and Honduras, that the ICJ decided a few years ago, may be cited. One problem that we had was that the boundary was a river boundary. The boundary line was the midpoint of the river mouth. This was resolved with the help of a committed of the OAS. And in 1962 it established an exact point, with coordinates. When we started the case with Honduras, in 2000, and started the measurements, this boundary had moved one kilometre and a half in forty years. Regarding the San Juan river, we are talking about 110 years that have passed and what is allegedly in dispute is a piece of land, a marsh of two square kilometres which they say has remained the same since the time of the Alexander award, which is not correct."

Following is an analysis of the elements raised in the statements by Argüello in light of this study's findings:

1) "*The border is a river, thus the border has no markers*". Indeed, the border is the right bank of the San Juan river and until 2010, the border had no markers in the disputed area; however, the geographical features and the location of the sketch map drawn in 1898 and approved in the Alexander Proceedings X of 2 March 1898 are identifiable. The survey recorded in the Proceedings X can be considered as a "digital delimitation" which, as has been demonstrated in this paper, coincides with the 2010 cartography of Nicaragua and Costa Rica. Costa Rica has used this topographical survey as one of its arguments that the boundary line has not changed; however, Nicaragua has only argued "that the river has changed" but it has not supported this assertion with a technical study.

2) "*...our maps, which have not been revised for 110 years – all our maps state that they have not been verified on the ground – and in light of the Alexander award, that the border cannot be where Costa Rica claims it to be, because it would contradict the mentioned award*." Although Argüello does not specify in this interview the award to which he is referring (first or second), the truth is that the boundary line accepted in the official cartography of both countries until 2010 is based on the Treaty of Limits of 1858, the two Cleveland awards (1888), and the Alexander awards of 1897-98 (112 years). To date, neither Argüello nor the technical staff of INETER have demonstrated with cartographical studies why the current boundary contradicts the second Alexander Award and the sketch map of 1898 and described in the Alexander Proceedings X of 2 de March 1898.

3) "*While in the field we discovered that reality was not clear and that it could not be what the Alexander award said it was. Conclusion: we cannot follow the situation as it has stood for 100 years and which has not been verified on the ground*". Once again, this argument is based on an unfounded contention on the part of Nicaragua. In contrast, this paper clearly and accurately demonstrates that the reality described by Alexander and recorded in the log of the Proceedings X of 2 March 1898 remains valid in 2010.

4) To illustrate the present dispute with Costa Rica, he refers to the dispute between Nicaragua and Honduras concerning another river: "*And in 1962 it established an exact point, with coordinates. When we started the case with Honduras, in 2000, and started the measurements, this boundary had moved one kilometre and a half in forty years. Regarding the San Juan river, we are talking about 110 years that have passed and what is allegedly in dispute is a piece of land, a marsh of two square kilometres which they say has remained the same since the time of the Alexander award, which is not correct*." Again, Mr. Argüello makes an assertion without providing cartographical or technical evidence in support and he assumes that if there were changes in the river in dispute with Hondureas over a 40 year period that there must be even greater changes that have taken place in the San Juan river over a period of 110 years. Based on the measurements taken in 1898 and approved by arbiter Alexander the same year and the evidence

presented in this stuffy, it is possible to affirm that the observed changes in te right bank of the San Juan river and in the Harbor Head lagoon do not support the arguments made by Mr. Argüello that the boundary line has changed. Moreover, as demonstrated in the previous section, there is a significant correlation between the sketch map of 1898 and the official cartography of Costa Rica and Nicaragua that existed until October 2010, and between the map and the aerial photographs of 1961, 1997 and the satellite images of 2010.

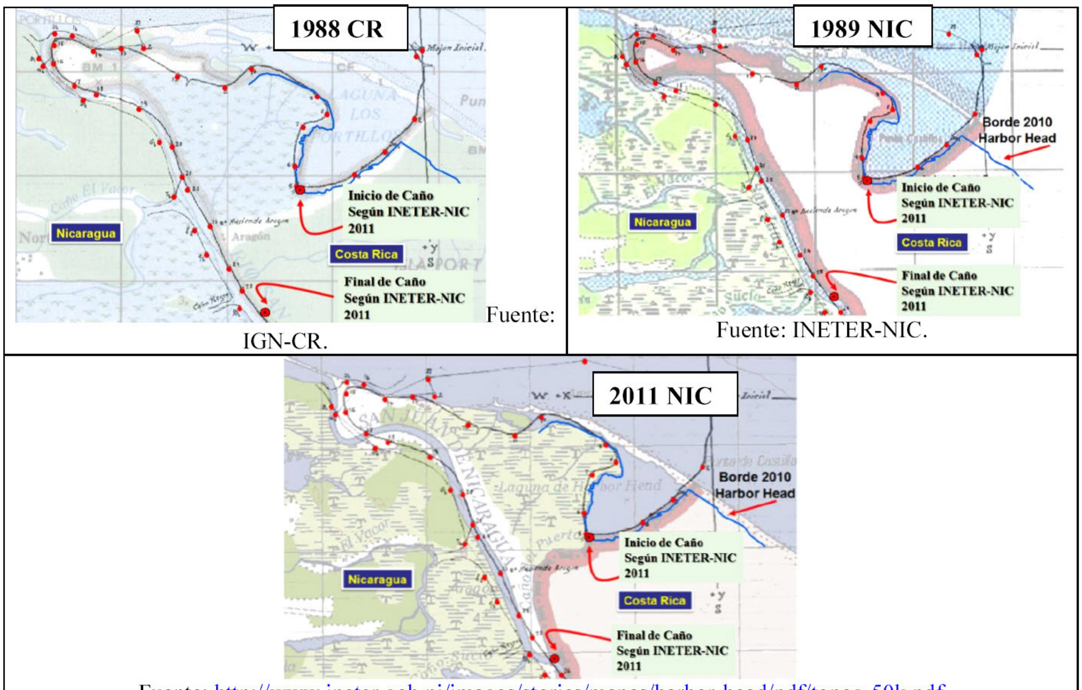
This study and the conclusions reached confirm the reasoning of Alexander to authorize the survey of the boundary line on 1897: "*The only effect obtained from measurement and demarcation is that the nature and extent of future changes may be easier to determine. There is no denying the fact that there is a certain contingent advantage to being always able to locate the original line in future... Costa Rica wants to have that future capacity*." In this study, use has been made of this contingent advantage, and it has been determined that the boundary line has not significantly changed and that there is no evidence to support a change to the boundary line between the two countries.

Nicaragua's new map

As demonstrated in the previous sections, in February 2011 the Nicaraguan Institute of Territorial Stduies (INETER, 2011) published a new map which incorporates the northeast sector of Portillos island as part of its territory (Fig. 11). According to INETER, the map was updated with satellite images of 2010 and the boundary is based on the Cañas-Jerez treaty of 1858, the Cleveland award of 1888, the Matus-Pacheco Convention of 1896 and the first Award of E. P. Alexander of 1897; with onsite corroboration (although it is indicated that the map is not fully verified on the ground) and the judgment of the International Court of Justice of 2009. INETER does not explain how or when the onsite verification was undertaken; nor does it refer to the maps and surveys that support the boundary between Costa Rica and Nicaragua was referred to above (pages 27 and 33 of the Proceedings X, March 1898) and which were reproduced in the second Award of E. P. Alexander in 1897.

The topographical survey of 1898 and the official maps of 1988-2010 indicate that the area that lies between Aragón farm-Los Portillos lagoon and the extreme northeast Punta Castilla has not undergone significant changes with the exception of a reduction of the width of the "channel" between the San Juan River and the Harbor Head lagoon and the loss of approximately 675 metres of coastline in Costa Rican territory in the eastern section of Punta Castilla. Given the evidence demonstrated in the preceding pages, it appears neither prudent nor wise for Nicaragua to disregard the consensus on the delimitation of the boundary previously accepted by the Nicaraguan Institute of Territorial Studies (INETER) and the National Geographic Institute of Costa Rica.

Figure 11 shows the great similarity that exists in the position and shape of the geographical features referred to by Alexander when he issued his First Award in 1897 (e.g "Harbor Head" lagoon, first "channel", San Juan river) and the representation of these features in the cartographical documents of 1988 and in the aerial photographs of 1961, which was used as the basis for the first official 1:50 000 scale map of Nicaragua and Costa Rica. Both the map and the corresponding log enable a visual verification of the location of the 1898 features in high-resolution satellite images taken in 2010. This "visual representation" of the log facilitates the interpretation of the text of the Treaty of Limits of 1858, the Cleveland Award of 1888, and the First Alexander Award of 1897, as well as the boundary approved by Alexander (p. 31 of the Proceedings X) as the following makes clear: "*...in compliance with the Award issued by the Engineer Arbiter on December 20th 1897, the* ***boundary line was measured*** *as described in the Award of September 30th of 1897, starting from the initial marker, following around the Harbor and through the first channel met up to the river proper, and through this until pole No. 40 next to the source of the Taura River*." *(Proceedings X, p. 31)* (emphasis added).



Fuente: IGN-CR.

Fuente: INETER-NIC.

Fuente: http://www.ineter.gob.ni/images/stories/mapas/harbor-head/pdf/topog-50k.pdf

Figure 11: Map on page 33 of the Proceedings X (2 March 1898) and its spatial relation to the official maps of Costa Rica and Nicaragua published until 2010. The dots indicate the survey approved by arbiter Alexander in March 1898. Note that the new boundary unilaterally adopted by Nicaragua in 2011 is not supported by the log in the Alexander Proceedings X of 1898. Reference system CRTM05.

Location of the first "channel" (caño) in the First Alexander Award 1897

Another aspect that this study clarifies is the location of the first "channel" to which Alexander refers in his First Award in 1897. Alexander, issued his award with the firm conviction that... "*Borders are intended to maintain peace, thus avoiding disputes over jurisdiction. In order to achieve that goal, the border should be as stable as possible*" (United Nations, 2007c), when referring to a body of water properly confined, visible on the ground, navigable and large enough to serve as a boundary between two nations. Note that navigation is a crucial aspect of the border treaty between Costa Rica and Nicaragua and it has been used as a criterion for the issuance of decisions by Cleveland, Alexander, and the International Court of Justice in The Hague in order to analyse earlier claims that arose between Costa Rica and Nicaragua.

Figure 12 shows the shape and the location of the Portillos lagoon-Portillos island in 1899 and in 1961. In the 1899 map it is evident where the "channel" referred to by Alexander is located, whereas only a remnant of the same "channel" is visible in the aerial photograph taken in 1961.

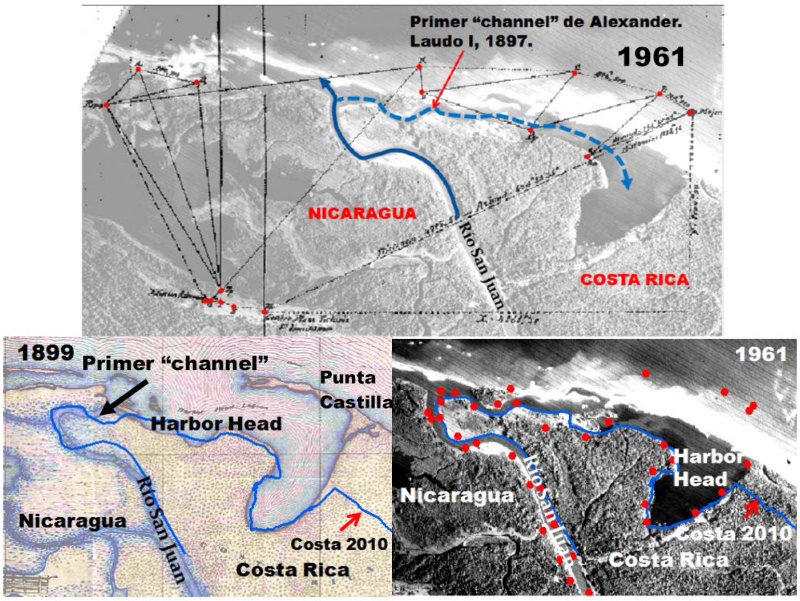


Figure 12: Boundary sketch map approved by arbiter Alexander in 1898 (red dots) and the location fo the first "channel" mentioned in the First Alexander Award of 1897. By 2010, the initial marker as well as points 1 and 2 of the sketch approved in March 1898 had been eroded by the Carribean sea. The dashed line indicates the direction of the water flow (from the San Juan river to the Harbor Head lagoon or Los Portillos lagoon). The solid arrow indicates the direction of the flow of the water in the San Juan river.

Following the reasoning of Alexander in his first Award (1897), the "first channel" corresponds to a body of water located in the extreme northeast of Harbor Head visible both on the map of 1899 and in the 1961 aerial photograph. This body of water fulfils the conditions outlined by Alexander in his First Award, namely:

"*On reaching the waters of Harbor Head Lagoon the boundary line shall turn to the left, or southeastward, and shall follow the water's edge around the harbor until it reaches the river proper by the* ***first channel*** *met.* ***Up to this channel****, and* ***up the river proper, the line shall continue to ascend as directed in the treaty***." (emphasis added).

Alexander's text shows the following:

1. That the water in the channel must flow from the San Juan river to the Harbor Head lagoon as the text refers to the watercourse by using the word "up" to mean to flow against the current or upstream. On the other hand, once the water reaches the San Juan river it must continue to "ascend" or to flow once again against the current. The identified body of water fulfils these two criteria and it is consistent with the term "channel" used by Alexander in the Award and with the concept of a waterway; as understood at that time.
2. There is cartographical evidence in 1899 that this "channel" existed and that is connected "Harbor Head" to the San Juan river.
3. The boundary coincides with the log recorded by the joint commissions that sketched the boundary line between Costa Rica and Nicaragua in 1898.
4. This "channel" fully complies with the conviction of Alexander that "*Borders are intended to maintain peace, thus avoiding disputes over jurisdiction. In order to achieve that goal, the border* ***should be as stable as possible***" (emphasis added) (United Nations 2007c).

In short, the evidence indicates that there is no boundary dispute and that Nicaragua has never questioned the contents of the Alexander Proceedings X of 2 March 1898 and thus for 110 years these have been accepted as a valid delimitation made on that date. In addition, both countries published official maps containing the identical boundary since 1970, and in fact the first edition of the topographical chart of Punta Castilla of Costa Rica was based on a map compiled by the Directorate General for Mapping of Nicaragua, on the basis of aerial photographs taken in 1961 (Lobo 2010). Nicaragua has disregarded the official maps, arguing that they lack onsite verification and also that "there have been changes in the course of the San Juan river"; an argument that has still not been demonstrated in technical studies. However, given the evidence presented in this study, there does not seem to be any technical or legal foundation for these arguments.

Conclusion

The conversion of the log that describes the location of the boundary line sketched in 1898 (Proceedings X, pp. 29-37) to the CRTM05 system used in the official cartography of Costa Rica in 2010, leads to the finding that the boundary line has not changed significantly over the course of the last 110 years to justify the argument of Nciaragua, which can be summarized in the position adopted by Argüello (2011) ... "*When we began the dredging works, announced five years ago, and the environmental impact of which was documented, we realized that our maps, which have not been revised for 110 years – all our maps state that they have not been verified on the ground – and in light of the Alexander award, that the border cannot be where Costa Rica claims it to be, because it would contradict the mentioned award.*" The evidence documented in this study supports the position of Costa Rica and it undermines the statements of Argüello. In summary, there does not exist a boundary dispute but rather a unilateral decision by Nicaragua to modify the boundary line.

Acknowledgements: The author wishes to thank the National Geographic Institute of Costa Rica for the cartographic and photographic material supplied and for its assistance.

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Annex 154

Sistema Nacional de Áreas de Conservación (SINAC), Ministry of Environment, Energy and Telecommunications of Costa Rica, Report, “Age approximation of trees cut in the Area under Costa Rica’s Environmental Management located on the causeway of the artificial channel built on a portion of territory of Calero Island to connect the San Juan River with los Portillos Lagoon”.

August 2011

SINAC

SISTEMA NACIONAL DE ÁREAS DE CONSERVACIÓN
AREA DE CONSERVACION TORTUGUERO

MINAET
Ministerio de Ambiente, Energía y Telecomunicaciones

''Age approximation of trees cut in the Area Under Costa Rica's Environmental Management located on the causeway of the artificial channel built on a portion of territory of Calero Island to connect the San Juan River with Los Portillos Lagoon¨

Miguel Araya Montero[1]

Introduction

In October 2010 the Tortuguero Conservation Area denounced an illegal intervention in the north end of Calero Island, reporting at that time the clear-cutting of a portion of forest and the demarcation of a causeway which apparently intended to connect the San Juan River with Los Portillos Lagoon through Costa Rican territory.

Shortly thereafter, the Government of Costa Rica collected evidence that the damages observed in October were being sponsored by the Government of Nicaragua and that an artificial channel was being built precisely on the causeway observed in October 2010 to connect the San Juan River with Los Portillos Lagoon, in connection with the dredging works on the San Juan River, which resulted in case presented by Costa Rica before the International Court of Justice at The Hague, Netherlands.

In March 2011 the International Court of Justice assigned the environmental management of the affected area to Costa Rica and allowed it to send environmental protection personnel to the area in question. Following this mandate and with the support of representatives of the Convention on Wetlands (Ramsar), the Government of Costa Rica performed an inspection of the affected area in April 2011 with the aim of gauging the damages observed.

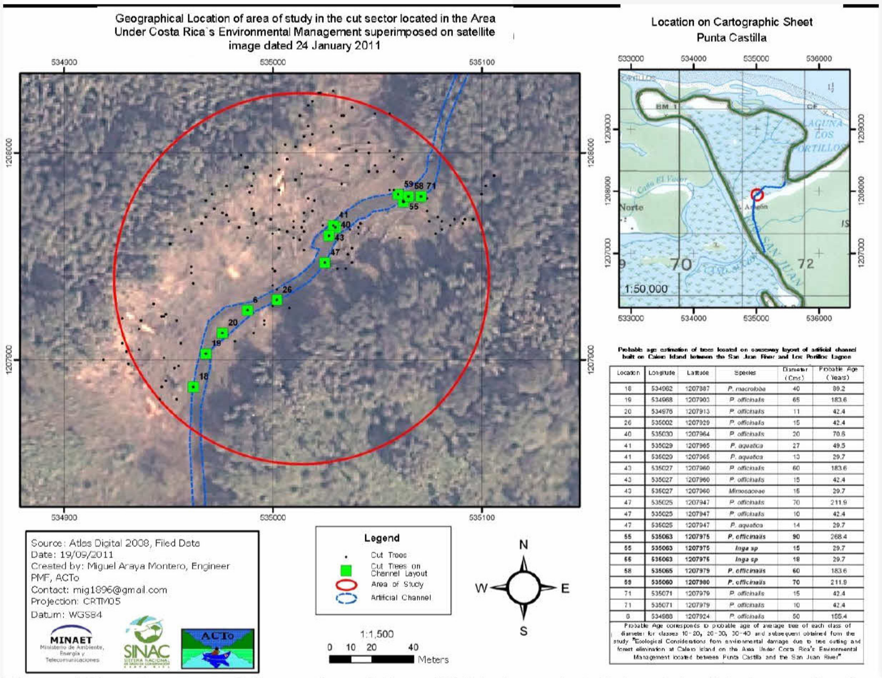
It was at the inspection held on 05 April 2011 that the existence of stumps of *Raphia taedigera* (yolillo) and *Pterocarpus officinalis* (Sangrillo) individuals in the causeway of the artificial channel was documented, being this fact a strong challenge to Nicaragua's claim in the sense that the works to connect the San Juan River with Los Portillos Lagoon obeyed the reestablishment of an existing natural channel and not the construction of an artificial one.

Based on forest growth information obtained by monitoring permanent sample parcels and photographic evidence obtained in inspections to the affected area, the present technical effort has as objective to estimate the approximate age of the cut trees of *Pterocarpus officinalis* (sangrillo) detected directly on the causeway of the artificial channel. This analysis excludes the individuals of the species *Raphia taedigera* (yolillo), since there are no scientific references about the growth of this species.

Figure 1 below shows the location where some cut trees were detected directly on the

[1] Director of the Forest Management Program of Tortuguero Conservation Area, SINAC, Costa Rica. (mig1896@gmail.com). August, 2011.

causeway of the artificial channel built. The table included therein indicates the estimated age of the trees.



Probable age estimation of trees located on causeway layout of artificial channel built on Calero Island between the San Juan River and Los Portillos Lagoon

Location	Longitude	Latitude	Species	Diameter (Cms)	Probable Age (Years)
18	534962	1207887	*P. macroloba*	40	89.2
19	534968	1207903	*P. officinalis*	65	183.6
20	534976	1207913	*P. officinalis*	11	42.4
26	535002	1207929	*P. officinalis*	15	42.4
40	535030	1207964	*P. officinalis*	20	70.6
41	535029	1207965	*P. aquatica*	27	49.5
41	535029	1207965	*P. aquatica*	13	29.7
43	535027	1207960	*P. officinalis*	60	183.6
43	535027	1207960	*P. officinalis*	15	42.4
43	535027	1207960	*Mimosaceae*	15	29.7
47	535025	1207947	*P. officinalis*	70	211.9
47	535025	1207947	*P. officinalis*	10	42.4
47	535025	1207947	*P. aquatica*	14	29.7
55	**535063**	**1207975**	***P. officinalis***	**90**	268.4
55	**535063**	**1207975**	***Inga sp***	**15**	29.7
55	**535063**	**1207975**	***Inga sp***	**18**	29.7
58	**535065**	**1207979**	***P. officinalis***	**60**	183.6
59	**535060**	**1207980**	***P. officinalis***	**70**	211.9
71	535071	1207979	*P. officinalis*	15	42.4
71	535071	1207979	*P. officinalis*	10	42.4
6	534988	1207924	*P. officinalis*	50	155.4

Probable Age corresponds to probable age of average tree of each class of diameter for classes 10-20, 20-30, 30-40 and subsequent obtained from the study "Ecological Considerations from environmental damage due to tree cutting and forest elimination at Calero Island on the Area Under Costa Rica's Environmental Management located between Punta Castilla and the San Juan River"

Figure 1. Location map of the section of the artificial channel at Calero Island between the San Juan River and Los Portillos Lagoon where the presence of stumps of *Pterocarpus officinalis* (sangrillo) was detected directly on the causeway of the artificial channel built in the area designated by the International Court of Justice as area under Costa Rica's environmental management.

From the picture above we can infer that in the area marked with a circle the width of the artificial channel ranges from about 6 to 7 meters wide.

In the same figure the black dots correspond to the location of the trees cut by 25 October 2010, while the points with square green symbols correspond to the location of cut trees which coincide in location with the causeway of the artificial channel built after that date. The caveat is made that the thirteen points shown with square green symbol in reality correspond to the approximate location of 21 cut individuals; the reason is because in the field in some places up to three cut trees were observed in the same location, so at that moment it was chosen to represent them with a single point.

Below are some pictures that show locations of the cut area as of 25 October 2010 and 05 April 2011.

Photo DSC_1076. Panoramic view of the northeast corner of the cut area shown in Figure 1. Photo taken on 25 October 2010.

In photo DSC_1076 it is shown that in that section of cleared forest, it was not observed evidence of the existence of a natural channel during the inspection carried out on October 2010.

Photo IGP_3909. Partial view of the affected area located in the northeast corner of the cut area shown in Figure 1. Photo taken on 25 October 2010.

In photograph IGP_3909, considering that the height of the officer in the center is just over 1.80 mts, it can be inferred that the base of the tree located in the upper left corner of the picture measures approximately 6 meters and its diameter exceeds 80 cms approximately one meter above the cut.

Photo IMG_0821. Partial panoramic view of northeast corner of cut area shown in Figure1. Photo taken on 5 April 2011.

In photo IMG_0821 it can be seen the appearance of the artificial channel in an area that as of October 2010 did not show signs of its existence. At the same time, it is observed that in the causeway of the said channel, in the section shown in the lower right corner there is a tree stump.

Photo IMG_0821-1. Corresponds to a partial enlargement of the lower right corner of the previous photo, where it is evidenced more clearly the existence of the stump mentioned for photo IMG_0821.

Photo IMG_0821-2. Corresponds to a partial enlargement of the lower right corner of photo IMG_0821-1.

If in Figure 1 was established that the width of the artificial channel in the area of study was about 6-7 meters, it can be inferred that the base of the tree located in the artificial channel measures at least 5 meters at its widest section.

Photo DSC_731. Partial view of stump shown in the previous photos. It can be observed that the stump covers over 60% of the artificial channel's width in that section. Photo taken on 5 April 2011.

Photo DSC_5440. Partial view of stump shown in previous photos. It can be observed that the stump covers over 60% of the artificial channel's width in that section. Photo taken on 5 April 2011.

Due to the location of the stump showed, it is probable that it corresponds to any of the trees cut at locations 55, 58 and 59 in Figure 1 which were surveyed during the inspection held on 25 October 2010 and recorded in the note ACTO-RNVSBC-CyP-058-2010. Due to the spatial distribution of the information, it most likely corresponds to a *Pterocarpus officinalis* tree, cut at the location identified by point N° 59 in Figure 1.

In the attached list, one can observe that for location No. 59, it is reported the cutting of a tree of the species *Pterocarpus officinalis* with a diameter of 70 centimeters. Therefore, considering the size ratio mentioned in photo IGP_3909, with a high degree of certainty we can conclude that the tree shown in the previous five pictures corresponds to tree N° 59 which had a diameter of 70 cm.

To determine the growth rate of the species *Pterocarpus officinalis*, the study called "Methodology for Calculating Carbon and CO2 from the Biomass in forests located in the CARFIX Area of Interest, using data from permanent parcels measured by FUNDECOR" can be used. This study used data from 339 permanent parcels measured by FUNDECOR, located on 37 farms, which include permanent sample parcels situated on farms owned by Northern Tecnoforest, located in the northern Caribbean region of Costa Rica. Through this study it was determined that *Pterocarpus officinalis* has a normal annual increment on average of 3.5 mm/year; nevertheless this average presents its minimum value in the category of 10-20 cm where it was observed a current annual increment of 1.5 mm/year, while the maximum growth was observed in the diameter categories of 30-40 cm with 4.4 mm/year.

According to the averages given in the aforementioned study, we have that statistically, with a level of confidence of 95%, the average growth rate of all diameter categories for *Pterocarpus officinalis* could range between 2.9 to 4 2 mm. Therefore, an average tree of the diameter class of 70-80 cm could be 211.9 years old, ranging its age between 178.3

and 261.1 years.

Based on the attached map in Figure 1 of this document, it is possible that in the causeway of the artificial channel remains may be found of at least 20 trees of different species and dimensions whose ages could reach up to 268.4 years. In addition, for the felled areas adjacent to the causeway of the artificial channel, individuals were identified with diameters of up to 130 cms of the species *Pterocarpus officinalis,* which could reach up to over 353 years of age.

Photo DSC_5434. Partial view of a stump of *Pterocarpus officinalis* located next to the artificial channel built in the forest area located in Calero Island between Los Portillos Lagoon and the San Juan River. Photo taken on 5 April 2011.

Photo DSC_5349. Partial view of a channel section located south of the felled area shown in Figure 1. One can see that at the center of the artificial channel there is presence of strains of *Raphia taedigera* (yolillo).

Photo DSC_5465. Partial view of channel section located adjacent to the area of cut forest shown in Figure 1. One can see that at the center of the artificial channel there is presence of strains of *Raphia taedigera* (yolillo)

Photo DSC_5316. Partial view of channel section located outside of the forest, towards the south of the felled area shown in Figure 1. One can see that at the center of the artificial channel there is presence of strains of *Raphia taedigera* (yolillo). It also shows the shallowness of the channel caused by a natural elevation of the ground.

Photo DSC_5439. Detail of a tree stump shown in photos IMG_0821, IMG_0821-1, IMG_0821-2, DSC_731 and DSC_5440, located on the causeway of the artificial channel built in the area of felled forest shown in Figure 1.

In addition to the trees cut down on the causeway of the artificial channel, mainly in the forest area shown in Figure 1, along the entire artificial channel several strains of *Raphia taedigera* (yolillo) were also observed. However, on the growth rate of the species *R. taedigera* references were not located in the consulted media. Despite the absence of scientific references, it was observed that this species does not have the capacity to establish itself on a channel with a water current because the buoyancy of its seed would prevent it from rooting into the soil. The same phenomenon occurs with most seeds of forest species, including the *Pterocarpus officinalis*.

Conclusions

On the causeway of the artificial channel built in the sector of Calero Island located between Los Portillos Lagoon and the San Juan River, in the area designated by the International Court of Justice as Area Under Costa Rica's Environmental Management, tree stumps of the species *Pterocarpus officinalis* were identified which could have had diameters of 70 cm and 90 cm, being individuals which may have had on average an age of 211.9 and 264.8 years, respectively.

The regeneration of species such as *Pterocarpus officinalis* and *Raphia taedigera* is very unlikely to have occurred on an existing natural or artificial channel due to the fact that the buoyancy of the seeds greatly decreases both species' chance of rooting into the ground.

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Annex

Inventory of trees cut in the sector of Calero Island located between Los Portillos Lagoon and the San Juan River as of 25 October 2010

GPS	Location	ID	Longitude	Latitude	Species	Name	Diameter (cms)	Vol (m^3)	A. Basal (m^2)	Probable Age (years)
Joaquin	14	1	534954	1207881	*Pterocarpus officinalis*	Sangrillo	55	2.32	0.24	155.4
Joaquin	15	2	534949	1207890	*Spondias mombin*	Jobo	43	1.25	0.15	89.2
Joaquin	16	3	534953	1207896	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Joaquin	17	4	534955	1207897	*Pachira aquatica*	Popenjoche	45	1.37	0.16	89.2
Joaquin	18	5	534962	1207887	*Pentaclethra macroloba*	Gavilán	40	1.08	0.13	89.2
Joaquin	19	6	534968	1207903	*Pterocarpus officinalis*	Sangrillo	65	3.27	0.33	183.6
Joaquin	19	7	534968	1207903	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	20	8	534976	1207913	*Pterocarpus officinalis*	Sangrillo	11	0.07	0.01	42.4
Joaquin	21	9	534982	1207909	*Pterocarpus officinalis*	Sangrillo	25	0.39	0.05	70.6
Joaquin	22	10	534991	1207913	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Joaquin	23	11	534996	1207917	*Pachira aquatica*	Popenjoche	30	0.6	0.07	69.3
Joaquin	24	12	534996	1207919	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	25	13	535000	1207926	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1

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Joaquin	26	14	535002	1207929	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Joaquin	27	15	535008	1207925	*Pachira aquatica*	Popenjoche	20	0.24	0.03	49.5
Joaquin	28	16	535002	1207934	*Pachira aquatica*	Popenjoche	15	0.14	0.02	29.7
Joaquin	29	17	535000	1207936	*Pterocarpus officinalis*	Sangrillo	25	0.39	0.05	70.6
Joaquin	30	18	535000	1207944	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Joaquin	31	19	535003	1207954	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	31	20	535003	1207954	*Pachira aquatica*	Popenjoche	15	0.14	0.02	29.7
Joaquin	32	21	535000	1207961	*Pachira aquatica*	Popenjoche	31	0.64	0.08	69.3
Joaquin	33	22	535003	1207963	*Pterocarpus officinalis*	Sangrillo	130	16.34	1.33	353.1
Joaquin	34	23	535007	1207962	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	35	24	535014	1207964	*Pachira aquatica*	Popenjoche	20	0.24	0.03	49.5
Joaquin	35	25	535014	1207964	*Pachira aquatica*	Popenjoche	12	0.09	0.01	29.7
Joaquin	36	26	535010	1207959	*Pterocarpus officinalis*	Sangrillo	65	3.27	0.33	183.6
Joaquin	36	27	535010	1207959	*Pterocarpus officinalis*	Sangrillo	65	3.27	0.33	183.6
Joaquin	37	28	535015	1207971	*Pterocarpus officinalis*	Sangrillo	12	0.09	0.01	42.4
Joaquin	38	29	535019	1207972	*Pachira aquatica*	Popenjoche	24	0.35	0.05	49.5
Joaquin	38	30	535019	1207972	*Pterocarpus officinalis*	Sangrillo	22	0.3	0.04	70.6
Joaquin	39	31	535011	1207987	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	40	32	535030	1207964	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Joaquin	41	33	535029	1207965	*Pachira aquatica*	Popenjoche	27	0.45	0.06	49.5
Joaquin	41	34	535029	1207965	*Pachira aquatica*	Popenjoche	13	0.1	0.01	29.7
Joaquin	42	35	535024	1207965	*Pachira aquatica*	Popenjoche	22	0.3	0.04	49.5
Joaquin	43	36	535027	1207960	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	43	37	535027	1207960	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Joaquin	43	38	535027	1207960	*Mimosaceae*	Mimosaceae	15	0.14	0.02	29.7
Joaquin	44	39	535015	1207962	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Joaquin	45	40	535013	1207958	*Pterocarpus officinalis*	Sangrillo	10	0.06	0.01	42.4
Joaquin	46	41	535015	1207953	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Joaquin	47	42	535025	1207947	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Joaquin	47	43	535025	1207947	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Joaquin	47	44	535025	1207947	*Pterocarpus officinalis*	Sangrillo	10	0.06	0.01	42.4
Joaquin	47	45	535025	1207947	*Pachira aquatica*	Popenjoche	14	0.12	0.02	29.7
Joaquin	48	46	535031	1207944	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Joaquin	48	47	535031	1207944	*Mimosaceae*	Mimosaceae	10	0.06	0.01	29.7
Joaquin	48	48	535031	1207944	*Mimosaceae*	Mimosaceae	12	0.09	0.01	29.7
Joaquin	49	49	535035	1207944	*Simphonia globulifera*	Cerillo	20	0.24	0.03	49.5
Joaquin	49	50	535035	1207944	*Mimosaceae*	Mimosaceae	5	0.01	0	29.7
Joaquin	50	51	535038	1207947	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	51	52	535036	1207951	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Joaquin	51	53	535036	1207951	*Simphonia globulifera*	Cerillo	10	0.06	0.01	29.7
Joaquin	52	54	535038	1207954	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Joaquin	53	55	535037	1207963	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	54	56	535061	1207959	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Joaquin	**55**	57	**535063**	**1207975**	***Pterocarpus officinalis***	**Sangrillo**	**90**	**7.38**	**0.64**	268.4
Joaquin	**55**	58	**535063**	**1207975**	***Inga sp***	**Guabilla**	**15**	**0.14**	**0.02**	29.7
Joaquin	**55**	59	**535063**	**1207975**	***Inga sp***	**Guabilla**	**18**	**0.2**	**0.03**	29.7
Joaquin	56	60	535058	1207982	*Pachira aquatica*	Popenjoche	25	0.39	0.05	49.5
Joaquin	57	61	535056	1207982	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9

Joaquin	62	69	535046	1207991	*Pterocarpus officinalis*	Sangrillo	53	2.15	0.22	155.4
Joaquin	63	70	535049	1207994	*Pachira aquatica*	Popenjoche	24	0.35	0.05	49.5
Joaquin	64	71	535046	1208000	*Casearea sp*	Casearea	10	0.06	0.01	29.7
Joaquin	64	72	535046	1208000	*Grias cauliflora*	Tabacón	14	0.12	0.02	29.7
Joaquin	64	73	535046	1208000	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	65	74	535040	1208001	*Simphonia globulifera*	Cerillo	24	0.35	0.05	49.5
Joaquin	65	75	535040	1208001	*Mimosaceae*	Mimosaceae	12	0.09	0.01	29.7
Joaquin	66	76	535032	1208002	*Pterocarpus officinalis*	Sangrillo	53	2.15	0.22	155.4
Joaquin	67	77	535028	1207992	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	68	78	535056	1208001	*Pterocarpus officinalis*	Sangrillo	29	0.52	0.07	70.6
Joaquin	69	79	535058	1207998	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	70	80	535062	1207997	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Joaquin	71	81	535071	1207979	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Joaquin	71	82	535071	1207979	*Pterocarpus officinalis*	Sangrillo	10	0.06	0.01	42.4
Joaquin	72	83	535074	1207978	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Joaquin	73	84	535074	1207972	*Pterocarpus officinalis*	Sangrillo	90	7.38	0.64	268.4
Joaquin	73	85	535074	1207972	*Grias cauliflora*	Tabacón	30	0.6	0.07	69.3
Joaquin	74	86	535075	1207967	*Pterocarpus officinalis*	Sangrillo	55	2.32	0.24	155.4
Joaquin	74	87	535075	1207967	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Joaquin	75	88	535079	1207969	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Joaquin	76	89	535081	1207967	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	77	90	535078	1207961	*Pterocarpus officinalis*	Sangrillo	29	0.52	0.07	70.6
Joaquin	78	91	535081	1207963	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Joaquin	79	92	535085	1207965	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	80	93	535087	1207968	*Pterocarpus officinalis*	Sangrillo	30	0.6	0.07	98.9
Joaquin	81	94	535091	1207966	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Joaquin	82	95	535091	1207966	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Joaquin	83	96	535092	1207968	*Pterocarpus officinalis*	Sangrillo	58	2.59	0.26	155.4
Joaquin	84	97	535096	1207968	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Joaquin	84	98	535096	1207968	*Grias cauliflora*	Tabacón	25	0.39	0.05	49.5
Joaquin	85	99	535100	1207980	*Pterocarpus officinalis*	Sangrillo	30	0.6	0.07	98.9
Joaquin	86	100	535102	1207984	*Pterocarpus officinalis*	Sangrillo	100	9.15	0.79	296.6
Joaquin	87	101	535106	1207989	*Spondias mombin*	Jobo	25	0.39	0.05	49.5
Miguel	1	102	534931	1207898	*Pentaclethra macroloba*	Gavilán	60	2.77	0.28	128.8
Miguel	2	103	534946	1207881	*unknown*	unknown	11	0.07	0.01	29.7
Miguel	3	104	534947	1207887	*Pterocarpus officinalis*	Sangrillo	14	0.12	0.02	42.4
Miguel	4	105	534948	1207901	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Miguel	5	106	534956	1207908	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Miguel	6	107	534988	1207924	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Miguel	7	108	535001	1207943	*unknown*	unknown	15	0.14	0.02	29.7
Miguel	8	109	535041	1207961	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9

Miguel	9	110	535041	1207964	*Pterocarpus officinalis*	Sangrillo	55	2.32	0.24	155.4
Miguel	10	111	535042	1207966	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Miguel	10	112	535042	1207966	*Pachira aquatica*	Popenjoche	20	0.24	0.03	49.5
Miguel	11	113	535033	1207985	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Olman	5	114	534919	1207900	*Pterocarpus officinalis*	Sangrillo	100	9.15	0.79	296.6
Olman	6	115	534930	1207904	*Pterocarpus officinalis*	Sangrillo	46	1.43	0.17	127.1
Olman	7	116	534928	1207908	*Pterocarpus officinalis*	Sangrillo	56	2.41	0.25	155.4
Olman	8	117	534928	1207920	*Pterocarpus officinalis*	Sangrillo	49	1.63	0.19	127.1
Olman	9	118	534936	1207915	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Olman	10	119	534936	1207905	*Pterocarpus officinalis*	Sangrillo	65	3.27	0.33	183.6
Olman	11	120	534937	1207919	*Pterocarpus officinalis*	Sangrillo	130	16.34	1.33	353.1
Olman	12	121	534943	1207927	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Olman	13	122	534947	1207921	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Olman	14	123	534948	1207921	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Olman	15	124	534949	1207922	*Pterocarpus officinalis*	Sangrillo	16	0.16	0.02	42.4
Olman	16	125	534954	1207919	*Pterocarpus officinalis*	Sangrillo	85	5.96	0.57	240.1
Olman	17	126	534962	1207937	*Pterocarpus officinalis*	Sangrillo	31	0.64	0.08	98.9
Olman	18	127	534961	1207942	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Olman	18	128	534961	1207942	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Olman	19	129	534961	1207945	*Pterocarpus officinalis*	Sangrillo	45	1.37	0.16	127.1
Olman	20	130	534951	1207956	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Olman	22	131	534958	1207963	*Pterocarpus officinalis*	Sangrillo	50	1.91	0.2	155.4
Olman	23	132	534961	1207962	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Olman	23	133	534961	1207962	*Pterocarpus officinalis*	Sangrillo	45	1.37	0.16	127.1
Olman	24	134	534966	1207966	*Pterocarpus officinalis*	Sangrillo	52	2.07	0.21	155.4
Olman	25	135	534968	1207969	*Pentaclethra macroloba*	Gavilán	16	0.16	0.02	29.7
Olman	26	136	534968	1207977	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Olman	28	137	534978	1207984	*Simphonia globulifera*	Cerillo	45	1.37	0.16	89.2
Olman	29	138	534971	1207980	*unknown*	unknown	13	0.1	0.01	29.7
Olman	30	139	534978	1207970	*Pterocarpus officinalis*	Sangrillo	90	7.38	0.64	268.4
Olman	31	140	534972	1207973	*Pterocarpus officinalis*	Sangrillo	70	4.01	0.38	211.9
Olman	32	141	534976	1207971	*Pterocarpus officinalis*	Sangrillo	62	2.97	0.3	183.6
Olman	33	142	534979	1207967	*Pterocarpus officinalis*	Sangrillo	14	0.12	0.02	42.4
Olman	34	143	534984	1207964	*Pterocarpus officinalis*	Sangrillo	64	3.17	0.32	183.6
Olman	34	144	534984	1207964	*unknown*	unknown	17	0.18	0.02	29.7
Olman	35	145	534988	1207959	*Pterocarpus officinalis*	Sangrillo	65	3.27	0.33	183.6
Olman	36	146	534992	1207966	*Pachira aquatica*	Popenjoche	39	1.02	0.12	69.3
Olman	37	147	534999	1207968	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Olman	38	148	534991	1207970	*Pterocarpus officinalis*	Sangrillo	66	3.37	0.34	183.6
Olman	39	149	534990	1207973	*Simphonia globulifera*	Cerillo	43	1.25	0.15	89.2
Olman	40	150	534991	1207971	*Pterocarpus officinalis*	Sangrillo	40	1.08	0.13	127.1
Olman	41	151	534990	1207984	*Simira maxonni*	Guaitil colorado	28	0.49	0.06	49.5
Olman	42	152	534989	1207981	*Simira maxonni*	Guaitil colorado	15	0.14	0.02	29.7
Olman	42	153	534989	1207981	*Simira maxonni*	Guaitil colorado	20	0.24	0.03	49.5
Olman	43	154	534991	1207990	*unknown*	unknown	42	1.19	0.14	89.2
Olman	44	155	534987	1207993	*Pachira aquatica*	Popenjoche	73	4.37	0.42	148.6
Olman	44	156	534987	1207993	*Pterocarpus officinalis*	Sangrillo	44	1.31	0.15	127.1
Olman	45	157	534985	1207999	*Pterocarpus officinalis*	Sangrillo	14	0.12	0.02	42.4

Olman	46	158	534988	1207993	*Pterocarpus officinalis*	Sangrillo	54	2.24	0.23	155.4
Olman	48	159	535002	1208000	*Grias cauliflora*	Tabacón	25	0.39	0.05	49.5
Olman	49	160	534999	1207989	*Pterocarpus officinalis*	Sangrillo	39	1.02	0.12	98.9
Olman	50	161	535003	1207992	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Olman	51	162	535003	1207982	*Simphonia globulifera*	Cerillo	23	0.33	0.04	49.5
Olman	52	163	535003	1207975	*Ceiba pentandra*	Ceiba	66	3.37	0.34	128.8
Olman	53	164	535010	1207967	*Pterocarpus officinalis*	Sangrillo	100	9.15	0.79	296.6
Olman	54	165	535010	1207964	*Pterocarpus officinalis*	Sangrillo	38	0.97	0.11	98.9
Olman	55	166	535015	1207967	*Pterocarpus officinalis*	Sangrillo	11	0.07	0.01	42.4
Olman	55	167	535015	1207967	*unknown*	unknown	21	0.27	0.03	49.5
Olman	57	168	535020	1207977	*Pterocarpus officinalis*	Sangrillo	24	0.35	0.05	70.6
Olman	58	169	535017	1207978	*Pterocarpus officinalis*	Sangrillo	29	0.52	0.07	70.6
Olman	60	170	535014	1207990	*Pterocarpus officinalis*	Sangrillo	60	2.77	0.28	183.6
Olman	61	171	535023	1207994	*Pterocarpus officinalis*	Sangrillo	23	0.33	0.04	70.6
Olman	61	172	535023	1207994	*Pterocarpus officinalis*	Sangrillo	20	0.24	0.03	70.6
Olman	62	173	535018	1208004	*Pterocarpus officinalis*	Sangrillo	16	0.16	0.02	42.4
Olman	63	174	535011	1208003	*unknown*	unknown	16	0.16	0.02	29.7
Olman	64	175	535006	1208004	*Pterocarpus officinalis*	Sangrillo	37	0.92	0.11	98.9
Olman	65	176	535007	1207997	*Pterocarpus officinalis*	Sangrillo	32	0.68	0.08	98.9
Olman	66	177	535017	1208013	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Olman	67	178	535019	1208009	*Ceiba pentandra*	Ceiba	62	2.97	0.3	128.8
Olman	68	179	535015	1208008	*Pterocarpus officinalis*	Sangrillo	19	0.22	0.03	42.4
Olman	69	180	535013	1208018	*Simphonia globulifera*	Cerillo	15	0.14	0.02	29.7
Olman	70	181	535019	1208025	*unknown*	unknown	38	0.97	0.11	69.3
Olman	71	182	535017	1208023	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Olman	72	183	535023	1208029	*Pterocarpus officinalis*	Sangrillo	15	0.14	0.02	42.4
Olman	73	184	535022	1208029	*unknown*	unknown	11	0.07	0.01	29.7
Olman	75	185	535029	1208030	*Pachira aquatica*	Popenjoche	41	1.13	0.13	89.2
Olman	76	186	535038	1208022	*unknown*	unknown	16	0.16	0.02	29.7
Olman	77	187	535034	1208018	*Pterocarpus officinalis*	Sangrillo	42	1.19	0.14	127.1
Olman	78	188	535033	1208018	*Pterocarpus officinalis*	Sangrillo	32	0.68	0.08	98.9
Olman	78	189	535033	1208018	*unknown*	unknown	10	0.06	0.01	29.7
Olman	79	190	535028	1208013	*Pterocarpus officinalis*	Sangrillo	39	1.02	0.12	98.9
Olman	80	191	535049	1208019	*unknown*	unknown	61	2.87	0.29	128.5
Olman	80	192	535049	1208019	*Pterocarpus officinalis*	Sangrillo	12	0.09	0.01	42.4
Olman	81	193	535056	1208019	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Olman	82	194	535029	1208010	*Pterocarpus officinalis*	Sangrillo	92	7.72	0.66	268.4
Olman	84	195	535046	1208005	*Lonchocarpus sp*	Chaperno	17	0.18	0.02	29.7
Olman	90	196	535035	1207994	*Pterocarpus officinalis*	Sangrillo	80	5.27	0.5	240.1
Olman	91	197	535036	1207994	*Pterocarpus officinalis*	Sangrillo	29	0.52	0.07	70.6

Rows highlighted in green correspond to individuals shown in Figure 1. Probable Age corresponds to probable age of average tree of diameter categories for classes 10-20, 20-30, 30-40 and subsequently obtained from the study "Ecological considerations of environmental damage due to tree cutting and forest elimination at Calero Island in the Area Under Costa Rica's Environmental Management located between Punta Castilla and the San Juan River".

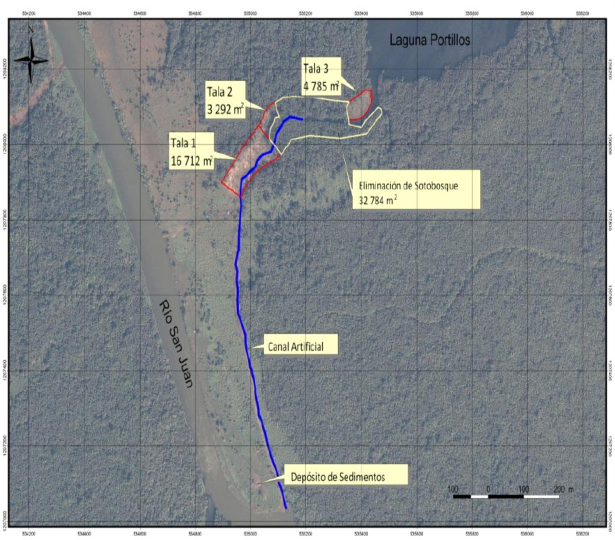
Annex 155

Ministry of Environment, Energy and Telecommunications of Costa Rica, Technical Report to Ramsar: "Assessment and evaluation of the Environmental situation in the Humedal Caribe Noreste within the framework of the Order of the International Court of Justice"

28 October 2011

Evaluation and assessment of the environmental situation in the North-eastern Caribbean Wetland (Humedal Caribe Noreste) pursuant to the Order of the International Court of Justice

TECHNICAL REPORT



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1. Background

As a result of the case brought by Costa Rica against Nicaragua before the International Court of Justice and the accompanying request for Provisional Measures, on 8 March 2011 the Court issued a Provisional Measures Order. In compliance with the second provisional measure contained in paragraph 86 of the Order, the Government of Costa Rica scheduled a visit for 5 and 6 April 2011 to the north-eastern sector of Isla Portillos, included in the North-eastern Caribbean Wetland (Humedal Caribe Noreste), registered by Costa Rica on the Ramsar Convention List of Wetlands of International Importance on 20 March 1996, which was henceforth designated a Study Area. The visit was organized in coordination with the Ramsar Secretariat for the purpose of carrying out an environmental assessment of the state of resources to determine actions to prevent further irreparable damage in that part of the wetland.

To this end, the Ministry of Environment, Energy and Telecommunications put together a team of experts and government officials from the National System of Conservation Areas of the Ministry of Environment, Energy and Telecommunications, the Costa Rican Institute of Electricity, the University of Costa Rica and the National University, who were appointed as experts on environmental protection.

The Costa Rican team of experts gave guidance to the experts appointed by the Secretariat of the Ramsar International Convention on Wetlands to carry out an assessment of existing environmental impacts that are leading to an irreversible change in the extreme north-east of Isla Portillos, a place where, since October 2010, changes to the wetland have been attributed to the impact of the presence of Nicaraguans, who constructed a canal, felled trees and deposited sediments, with an evident environmental impact on the study area.

2. Aims

2.1 General aim

The aim of this technical report is to present the results of the visit made to the site in compliance with the Order of the International Court of Justice of 8 March 2011. The main aims of the visit to the site were the identification and technical evaluation of the environmental situation of the study area to determine the consequences of the works carried out, the impact chains initiated, their implications and the preventive, corrective, mitigating or compensatory environmental measures that would need to be implemented to restore the natural environmental balance of the site to avoid new, irreparable changes to the wetland.

2.2 Specific aims

The specific aims of the study undertaken are as follows:

a. To compile and integrate the information available on **surface water** and associated sedimentological aspects of the study area to enhance field data obtained on the visit, so as to have a basic conceptual model to form the basis of the assessment of the impact caused by the construction of the artificial canal, as well as projecting the environmental impact it has generated, and might continue to produce.
b. To obtain basic geological and sedimentological information of the study area to establish a **basic hydrogeological model** and establish the immediate, short-term and medium-term direct and indirect impact caused by the construction of the drainage canal and potential transfer of water from the San Juan river to the Los Portillos lagoon.
c. To compile technical information in the field on the depositing of **sediments** extracted in the San Juan riverbed and dumped in the study area to gauge the area and resultant environmental impact. In addition,

to compile information on materials extracted during the excavation of the artificial canal and deposited in the study area.

d. To collect technical information on the **forestry, biology and ecology** of the area affected by the works carried out in the study area to ascertain their condition at the time of the analysis and since the works began, to use for comparative purposes with the inventory drawn up for those subject areas in October 2010, to enable an estimate to be made of ecological impact, its extent and also the resultant environmental impact chain.

3. Context

It is important to note the difficulties encountered during this technical visit to the zone, since during the mission the Ramsar technical team and the government officials concerned were harassed by Nicaraguan citizens who took up position in the study area scheduled for inspection.

The Costa Rican technical experts, accompanied by the technical experts of the Ramsar Convention Secretariat, entered the area on 5 April 2011; on 6 April, however, it had been impossible to enter due to the presence of a number of Nicaraguans in the area, preventing the helicopters from landing. Nevertheless, flights were made over the area instead to complete the data collection. The visit to the site on 5 April, complemented by the flyovers that took place on 6 April, enabled sufficient basic information to be obtained to produce this report, so that the desired objectives of the visit were achieved.

It should also be noted that some data collected between 22 and 25 October 2010 and assessments carried out in the months of November and December 2010 have had to be amended, given that certain new activities, such as further tree felling and excavation works on the new artificial canal, occurred after those dates. Thus, there are now new analyses and data amending previous estimates.

4. Study Area

The study area, indicated in Figure 1, is located in the extreme north-east of Isla Portillos and is part of the Refugio Nacional Corredor Fronterizo (Border Corridor National Refuge) and the Humedal Caribe Noreste, registered by Costa Rica on the Ramsar List of Wetlands of International Importance on 20 March 1996. It corresponds to the area stated as being "in dispute" by the International Court of Justice in its Order of 8 March 2011. As can be seen in Figure 1, it is bordered to the south by the canal opened in November 2010 between the San Juan river and the Los Portillos lagoon; to the west and north-west by the San Juan river; and to the east and north-east by the Los Portillos lagoon and the Caribbean Sea.

The affected zone and the surrounding areas are very wet sites, with hydrophilic vegetation and hydromorphic soils, predominantly associated with Yolillal (swamp forest), which cover 226.18 ha in total.

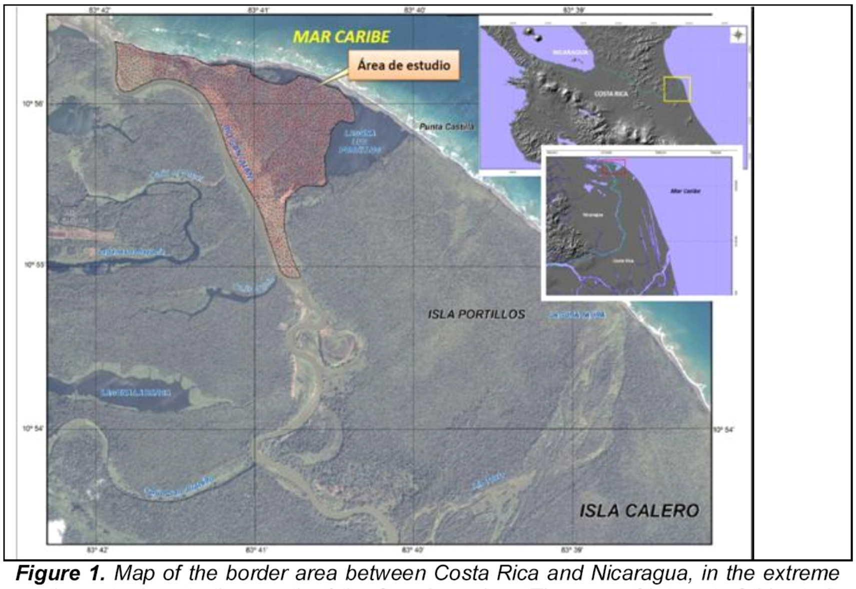

Figure 1. *Map of the border area between Costa Rica and Nicaragua, in the extreme north-west, close to the mouth of the San Juan river. The area of interest of this study is marked out in red. The inset boxes show more regional maps of the location for the study area.*

The site in particular has areas of tall grasslands that are located in the extreme south-east of the study area, some small areas to the north of the aforementioned portion of land and a larger proportion in the extreme north-west of the area next to the mouth of the San Juan river. Towards the west, between the areas of tall grasslands and on the banks of the San Juan river, there is an area of livestock pasture extending to the east to an area of flooded forest, which has the features of a wetland marsh system.

The latter forms part of a very extensive block of flooded forest that covers the region. It borders the Los Portillos lagoon in the western sector.

Four areas to be assessed were selected for the study, which are described below (see **Figure 2**).

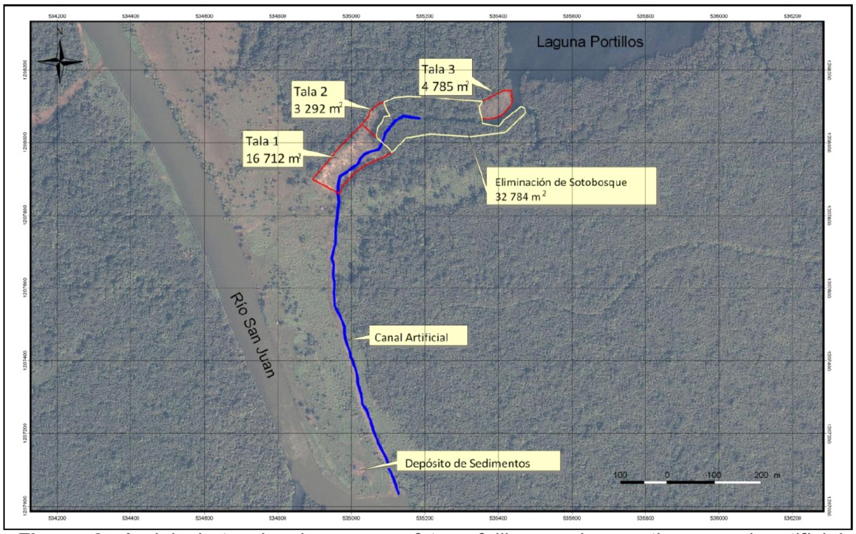

Figure 2. *Aerial photo showing areas of tree felling, undergrowth removal, artificial canal construction and sediment deposits.*

Area of recent deforestation: See designated areas labelled Tala1 (deforestation area 1), Tala2 (deforestation area 2) and Tala3 (deforestation area 3) in fig. 2, corresponding to a wetlands area, associated especially with Yolillal (swamp forest), where tree species adapted to very high levels of humidity (hydrophilic vegetation) predominate, such as *Pterocarpus officinalis*, *Simphonia globulifera*, *Pentaclethra macroloba*, *Pachira aquatica* and palms such as *Raphia taedigera*, *Astrocaryum alatum*, et al. Two deforestation fronts were observed; the smallest located next to the Los Portillos lagoon, while the other is situated more towards the south-west approximately 300 metres from the San Juan river.

Area of undergrowth removal ('socola'): Conditions are similar to those in the aforementioned area, since both correspond to the same block of flooded forest present in the site (called freshwater forested wetlands, according to the Ramsar classification). This area extends from the deforested area to the banks of the Los Portillos lagoon, bordering the rest of the flooded forest on its other two sides, covering areas both to the north and the south of the channel of the artificial canal. It presents a relatively rectangular shape which is aligned with the deforestation fronts, as shown in the area marked out in yellow in fig.2.

On this site, the Nicaraguan work crews removed all the low-lying vegetation (mainly palms, seedlings and saplings), leaving underfoot only stumps and mature trees, mostly the species P. *officinalis*. From the features of the undergrowth removal, it was ascertained that this clearing, or 'socola', of the area occurred between October 2010 and March 2011.

The progress of these works can be seen in the satellite photographs, which show the initial step of clearing the area and subsequent tree felling. It should be pointed out that some seemingly permanent surface water can be seen in this area. According to the evidence, the undergrowth removal that took place was the preliminary stage of the total removal of vegetation to extend the deforested area. It could therefore be ascertained that there was an impact on the areas of hydric protection.

Artificial canal: It is an area of manual excavation and is marked out in blue in fig. 2, which includes removal of individual species of the *Poaceae* family and the clearing of species such as the Yolillo (*Raphia* *taedigera*) and Sangrillo (*Pterocarpus Officinalis*), which begins on the right bank of the San Juan river to the east of the area of sediment deposits and continues in a northerly direction for 800 metres, then changing course towards the north-east for 408 metres until reaching a drainage channel of the wetland's surface discharge which runs into the Los Portillos lagoon, the man-made trajectory measuring approximately 1,208 metres in total. When the inspection was conducted on 25 October 2010, the canal did not exist, thus its construction must have begun at the beginning of November of that year, which was at the time an area occupied by the Nicaraguan army.

Area of sediment deposits: in the pasture area of the Finca Aragón, sediments extracted from the San Juan riverbed were deposited 30 metres in distance from the riverbed. This area, identified in the lower part of fig. 2, is 750 metres from the deforestation and undergrowth removal areas and near to the beginning of the pathway area where the artificial canal was subsequently excavated. These compacted sediments have acted as "solid ground" on which to set up camps.

Table 1 below shows land use for the study area as observed from an optical satellite image taken on 2 January 2011.

To differentiate between areas catalogued as grazing land and tall grasslands, grazing areas must include areas characterized by the predominance of low pastures of up to 0.5 m high and the presence of isolated trees, which is denoted by the occasional use of the grazing land for an unspecified quantity of cattle.

Table 1

Land use corresponding to the study area

As at 2 January 2011

Land use	Area (ha)	Percentage (%)
Forest with yolillo	143.50	63
Grazing	37.60	17
Tall grasslands	45.08	20
Total	**226.18**	**100**

Source: Field data and optical satellite image of 2 January 2011

On the other hand, the areas of tall grasslands correspond to areas characterized by the presence of pastures up to 1.5 metres high, wide-leaved bushes of a similar size and the incipient regeneration and dispersal of forest species and *Raphia taedigera* (yolillo). Areas of tall grasslands are also characterized by the presence of flooded land with a limited support capacity.

5. Methodology

5.1 PRELIMINARY PHASE

As a preliminary field work phase, the Government and technical experts of Costa Rica undertook some preparatory work for the visit to the study area, which is described below. Prior to the visit, the work protocol and planned activities were discussed with the members of the Ramsar Convention team. The following are some of the activities undertaken during the preliminary phase:

a. Establishment of the team of experts by the Ministry of Environment, Energy and Telecommunications, taking into account the knowledge and experience of its members in fields such as wetland research and management, especially in the north-eastern Caribbean. The members of the multidisciplinary technical team in question are included in the list contained in Chapter 11 of this document.
b. This multidisciplinary team is considered to be the "nuclear" team that would concentrate on assuming responsibility for the technical studies to be carried out. This does not preclude the use of other professionals and laboratories should their additional input be required, as a complementary support for the tasks to be undertaken to achieve the objective set.
c. Once the technical team had been established, a work protocol was drawn up to establish the steps to be followed during the environmental assessment and whose tasks by activity are indicated below.
d. The commission's work began with the analysis of aerial photographs prior to the canal construction works being carried out on the site.
e. An assessment was made of satellite images and photographs taken during and after the works were carried out in the wetland, as well as the

compilation, processing and integration of technical information available for the study area prior to the commencement of works.

f. A synthesis of the environmental condition of the study area was made, prior to works being carried out, in order to establish the "ex ante" state and its environmental condition.
g. Data obtained during a previous inspection carried out on 25 October 2010 by officials of the National System of Conservation Areas in the area were also examined, including an inventory of the trees cut down at that time, to ascertain the changes brought about to date.

5.2 SURFACE WATER

This refers to the series of tasks established to assess the environmental situation of the study area with respect to the condition of drainage, particularly with regard to the impact of the construction of the artificial canal and its sedimentological effects. These tasks included:

a. Technical assessment of the open canal, including its dimensions, water flow situation and its condition with respect to erosion/sedimentation balance.
b. Assessment of the hydraulic and hydrological condition of the canal and its net effects on water transfer of the San Juan river to the Los Portillos lagoon.
c. Analysis of the condition of local drainage in the study area through the interpretation of photographs and review of field data.

5.3 GROUNDWATER

This involves reviewing the local geological and hydrogeological condition to establish a local hydrogeological model to serve as a reference for the analysis of actions taken and a forecast of the consequent effects of those actions. The following tasks were carried out:

a. Geological-sedimentological analysis of the different sedimentary environments and sub-environments of the study area, through the interpretation of recent photographs of the area and field data.
b. Identification of the types of sediments existing in some of the sedimentary sub-environments of the study area and at groundwater level.
c. Creation of the local conceptual hydrogeological model of the study area and diagnosis and forecast of the environmental situation created and its impact.

5.4 SEDIMENTS

This relates to the site within the study area where sediments dredged from the San Juan river were deposited and used as part of the military camp erected during the works carried out by the Nicaraguans. The following were the tasks set to assess this component of the study:

a. Environmental assessment of the land to the north of the canal, with particular emphasis on the site where the camp had been erected and other relevant activities to ascertain its environmental impact on the protected area.
b. Measurement of the area where sediments were deposited and assessment of the environmental condition of the site.

5.4 FLORA AND FAUNA (ECOLOGICAL ASPECTS)

This activity includes an analysis of the environmental impact on the flora and fauna of the study area due to the activities carried out during the period from October 2010 until when the inspection was carried out. The following tasks were undertaken as part of this activity:

a. Field assessment of the ecological impact caused by the opening of the artificial canal in the study area.

b. Forestry and biological assessment of the area used for the camp located in the study area.
c. Forestry and biological assessment of the deforestation areas, with particular emphasis on a comparative analysis of information collected in October 2010, to quantify the direct environmental impact produced in the study area.
d. Comparative inventory of the condition of the forest cover affected by the works, including the impact on the biodiversity of the wetland.
e. Comprehensive ecological assessment of the study area as a result of human actions in the wetland area.

5.5 DATA INTEGRATION AND PREPARATION OF TECHNICAL REPORT PHASE

This refers to the series of tasks carried out subsequently on the direct inspection work of the study area, involving processing data by subject area, their interaction and drafting this technical report. It also includes the work plan of new activities to undertake as part of the process of diagnosing and providing an update on the environmental situation:

a. Integration of the multidisciplinary information compiled, by carrying out an assessment of impacts detected, following existing standardized methodology, and forecasting the impact chains that would be generated in the future.
b. Comparative analysis of the “ex ante” situation and “ex post” situation.
c. Assessment and qualification of environmental impacts detected.
d. Forecast of likely level of environmental impact, according to the results obtained.
e. Establishment of preventive, corrective, mitigating or compensatory environmental measures to implement in order to prevent any further irreparable changes.

f. Recommendation of corrective actions to implement to recover the wetland, such as a suitable mechanism to prevent any further irreversible degenerative processes.
g. Drafting of the technical report, including a work plan on actions to take with respect to enhancing environmental assessment information generated for the study area.
h. The technical team had access to optical satellite images via the Ikonos satellite for use in its analysis, with a spatial resolution of one and a half metres. The images used were taken on the dates of 8 August 2010, 19 November 2010, 14 December 2010, 2 January 2011 and 24 January 2011. Those images were georeferenced by the National Geographic Institute using the official system for Costa Rica, which uses the reference system CR05 with the WGS84 datum and the Costa Rica TM 2005 (Transverse Mercator) (CRTM05) as its projection. In addition, the National Geographic Institute provided a series of aerial photographs of the Punta Castilla sector duly georeferenced for the years 1961, 1981, 1986 and 1997.
i. For field data collection, GARMIN GPS navigators (GPSmap76CSx and GPSmap60CSx) were used and the position format of the data taken was in decimal degrees and the WGS84 datum. The mean error anticipated during data collection was 2 to 5 metres.
j. The programme used to digitalize the satellite images was Arc View 3.3., and extensions to carry out different transformations and processes are: Cr_proy_datum_2008 to transform the field coordinates to CRTM05, Geoprocessing to cut and unite Shapes, image analysis to use the satellite images, and xtools extensión_meters/hectares to make the calculations of the areas.

6. Results

6.1 SURFACE WATER

The hydrometeorological situation during the visit was the dry season, which means that the water volumes of the San Juan river were low, the humidity of the soils was relatively low, the groundwater levels were relatively deep and the level of the Los Portillos lagoon was relatively low.

The study area, from the sedimentological point of view, is characterized as being a deltaic environment, made up of sedimentation banks, meandering channels, parallel systems and longitudinal coastal sandbanks. The area of interest represents a prograding microdelta of the "crevasse splay" type, originating from overflows from the San Juan river and also through progradation of meandric sedimentation in the extreme north–northwest (see **Figures 3a and 3b**).

6.1.1 Artificial canal

Figure 3.a shows a photograph taken in January 2011 of the area of interest and its surroundings. As can be observed in interpreting this photograph (see **Figure 3.b**), an open artificial canal appeared between the end of October 2010 and January 2011, for the purpose of establishing a hydraulic connection between the San Juan river and the Los Portillos lagoon.

The field work carried out on 5 April 2011 enabled technical information on the artificial canal to be collected along an approximate stretch of 800 metres, from its beginning at the right bank of the San Juan river, up to the deforestation site of October 2010, as per the geographical reference points given in **Figure 4**.

Fig. 3.a. *Photograph of 2 January 2011 showing the position of the study area.*

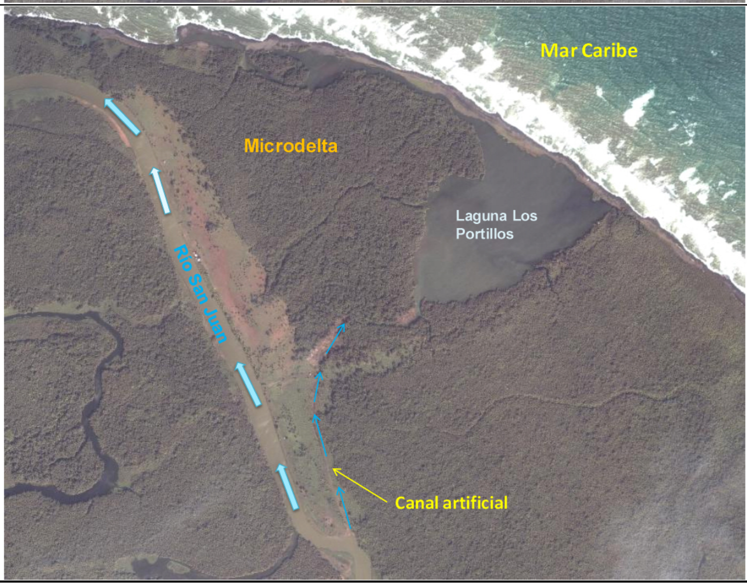

Fig. 3.b. *Main units of the photograph, including the open artificial canal.*

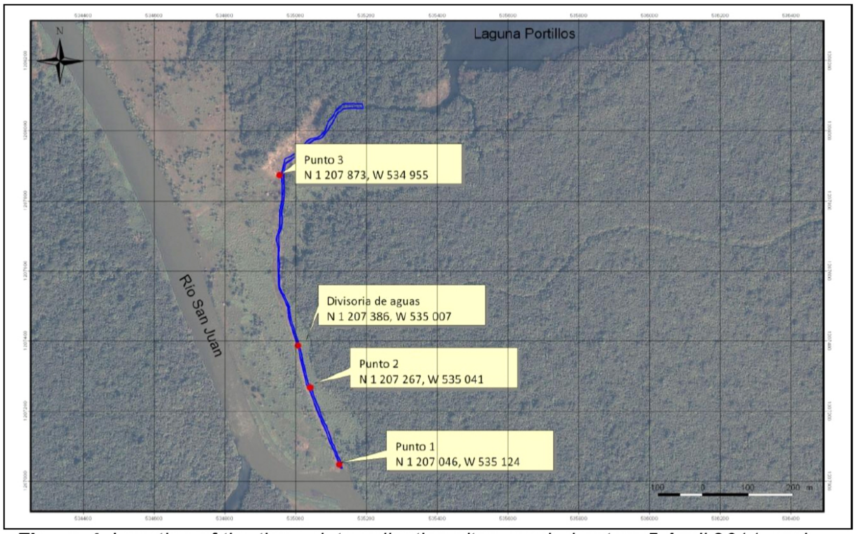

Figure 4. *Location of the three data collection sites, carried out on 5 April 2011, and the drainage divide site.*

Data collection site 1 corresponds to the beginning of the artificial canal, at coordinates N 1207046 and W 535124 (**See Figure 5**). In this cross section, it had been possible to measure the dimensions of the canal at this site, yielding the following information: the surface width, between banks, is 5.30 metres, the average depth of the canal is 1.25 metres and the water level is 0.60 metres. It was observed that the walls of the canal are made up of medium grain sand, and that the sediment deposited in it corresponds to silt (mud and clay mixtures).

Figure 5. Site 1: *Beginning of the artificial canal on the right bank of the San Juan river. In the background a boat with some of the Nicaraguans who harassed mission members.*

In site 2, located at coordinates N 1207267 and W 535041, approximately 300 metres to the north of site 1, on the artificial canal and in the direction of the Los Portillos lagoon **(see Figure 6)**, a second measurement was taken of the dimensions of the cross section of the artificial canal.

This cross section of the canal provides clear evidence of sedimentation. The surface width, between banks, is 4.2 metres, the depth of the canal is 0.6 metres and the water level only amounts to 0.2 metres. The walls of the canal are of silt and fine sand and the sediment within the canal is composed of silt. In this sector the canal water, as in site 1, flows in the direction of the San Juan river.

Figure 6. *Artificial canal measurement site 2, located 300 metres from site 1.*

Close to the so-called Finca Aragón, a third measurement was taken of the dimensions of the transversal section of the canal. This site is located approximately 800 metres from the initial section of the canal, in site 1, at coordinates N 1207873 and W 534955 (**see Figure 7**). In site 3, the canal has a surface width, between banks, of 5.20 metres, a depth of 1.5 metres and the water level is 1.0 metre. The canal water flows in the direction of the Los Portillos lagoon. In site 3, the canal walls are fine to medium sand and the sediment is silt. In this site it had been possible to take measurements of the approximate water flow, which was 0.7 m^3/s, with a speed of 0.13 m/s.

En route between sites 2 and 3, a change was observed in the direction of water flow approximately 580 metres from the beginning of the canal, in the site identified with coordinates N 1207386 and W 535007 (**see Figure 4**).

Figure 7. *Artificial canal measurement site 3, located 800 metres from site 1. Sediments dumped on both sides of the canal were observed.*

It is important to mention that, given that the measurements were taken during the month of April, from the hydrometeorological point of view it corresponds to a period of low water levels, i.e. low water flows in the San Juan river, suggesting that the condition observed could be different during the rainy season. The diagram in **Figure 8** shows the geomorphological interpretation model of the situation of the canal under conditions of low water flow in the San Juan river at the end of the dry season (period of low water levels).

In line with this model, and the aforementioned observations made on sites 1-3, approximately 580 metres from the beginning of the canal is a drainage divide, which causes the water of the artificial canal to flow in the direction of the San Juan river when there are low water flow conditions in the San Juan river. From the other side of that drainage divide, the geomorphological condition and topographical gradient allows the water of the artificial canal to be displaced in the direction of the Los Portillos lagoon.

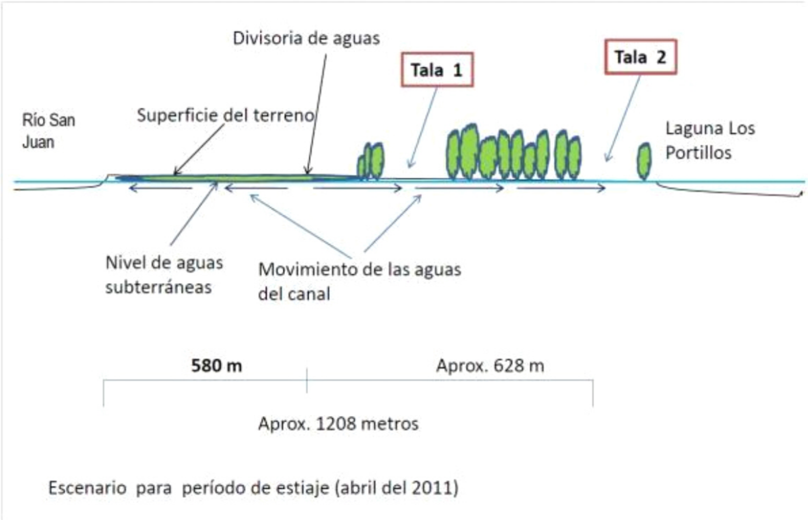

Figure 8. Interpretive model of the status of the artificial canal in conditions of low water flow (period of low water levels) in the San Juan river.

The situation described is evidence that under conditions of low water flow in the San Juan river, as at the time of the visit, there is no hydraulic connection between the river and lagoon and thus no resultant deposits of sediments from the river to the lagoon. Hence, it occurred immediately after the canal was opened during a period when the San Juan river flooded in December 2010.

In **Figure 9.a**, which is a photograph taken on 5 December 2010 when the San Juan river was in flood, a plume of sediment can clearly be seen entering the Los Portillos lagoon, transported by water from the San Juan river via the artificial canal.

It is important to note that the San Juan river flood also caused a temporary rise in the regional groundwater level and thus the hydraulic connection with the lagoon. However, these conditions would not lead to the movement of sediments; that happened because of the existence of the artificial canal (see **Figure 9.b**).

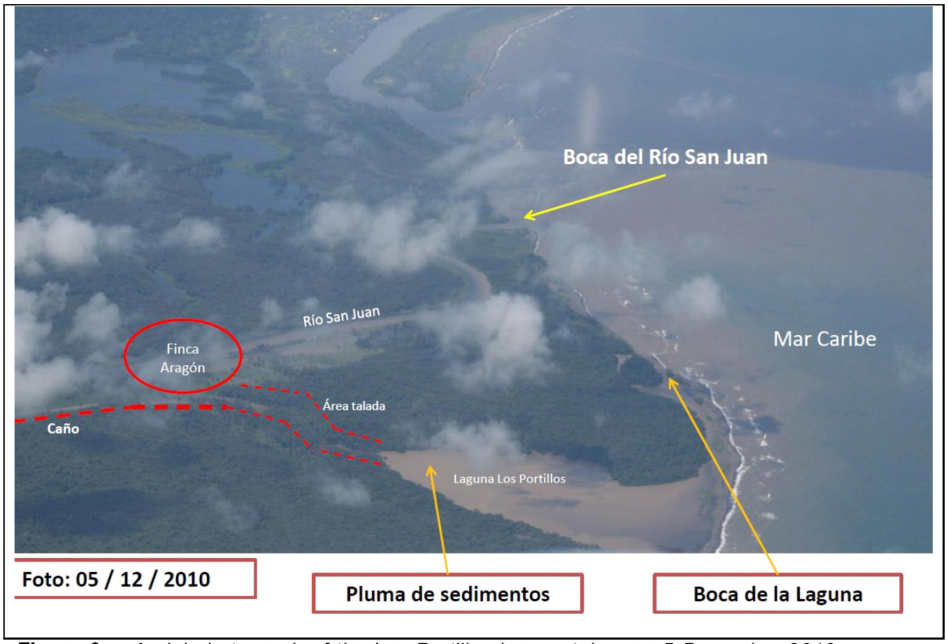

Figure 9.a. *Aerial photograph of the Los Portillos lagoon taken on 5 December 2010. The plume of sediment can be seen entering the lagoon from the river via the artificial canal.*

In **Figure 10**, the area of the beginning of the artificial canal and the land conditions are shown as on 5 December 2010. As can be seen in the photograph in Figures 10 and 11, when the water flow of the San Juan river is high some of the river water passes through the artificial canal towards the Los Portillos lagoon.

In the light of the above, **Figure 11** shows the model to interpret the situation of the artificial canal under conditions of a significant rise in water flow in the San Juan river. In these circumstances, there is an effective transfer of water and sediments from the San Juan river via the artificial canal towards the Los Portillos lagoon, with the formation of a plume of sediment in the latter and a consequent loss of the environmental quality of its waters.

Figure 9.b. *Aerial photograph of 5 December 2010 during a flood period of the San Juan river, which shows it transporting a substantial amount of sediments, and how the artificial canal opened up by the Nicaraguans allows a direct hydraulic connection between the river and the Los Portillos lagoon, which is how the sediments of the river pass via the canal towards the lagoon, altering its environmental quality.*

The construction of the artificial canal to connect the Los Portillos lagoon to the San Juan river, and eventually to the Caribbean Sea, together with primary forest deforestation, has had the greatest impact within the wetland. Should the transport of sediment from the San Juan river to the Los Portillos lagoon occur, the potential consequences indicated in page 20 of the Ramsar Mission Technical Report would be confirmed[1]: *"The changes are apparent in the change in the river's rates of discharge and transportation of sediment between the river and the lagoon. Similarly, the consequent effect will be a possible change in the local water balance. On the other hand, the existing hydrodynamic balance in this area, from the Pleistocene-Holocene era (see the section on geology) will be altered, with a consequent change in the water quality of the halocline[2]."*

[1] See Ramsar Advisory Mission (RAM) Report No 69 of 11 January 2011, page 20.
[2] Halocline: Layer in a stratified water mass with the maximum gradient of salinity.

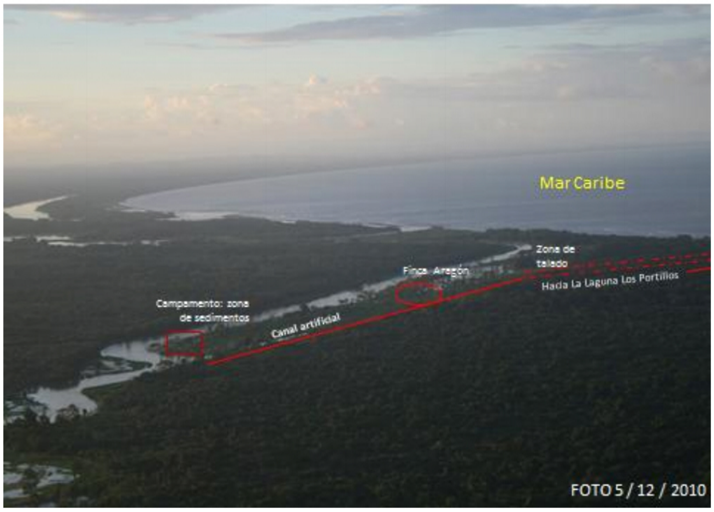

***Figure 10**. Aerial photograph of 5 December 2010, during a time of significant rise in water flow in the San Juan river, due to increased precipitation.*

By contrast, **Figure 12** shows an aerial photograph taken in the Los Portillos lagoon on 5 April 2011, a period of low water levels, when clearly no plume of sediment is apparent whatsoever and, moreover, the coastal sandbank, in Punta Castilla, remains unaltered, with no direct connection between the Los Portillos lagoon and the Caribbean Sea.

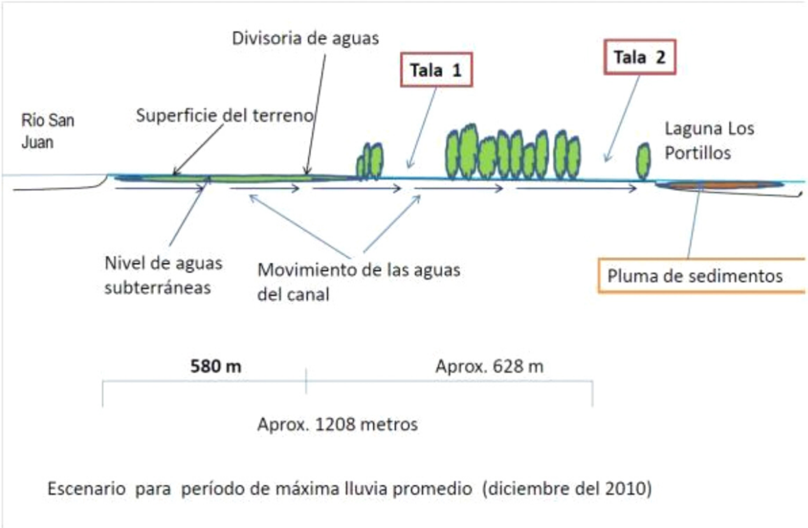

Figure 11. Interpretive model of the status of the artificial canal during periods of increased water flow in the San Juan river.

The changes in the transport of water towards the lagoon will have to be measured in the rainy season since, as indicated above, the visit of 5 April was made in a period of low water levels and during a particularly dry year.

It was also observed that the materials extracted during the construction of the artificial canal were dumped on both banks of the excavated waterway.

Figure 12. *Aerial photograph of the Los Portillos lagoon taken on 5 April 2011.*

The materials dumped were between 0.50 and 1.50 metres thick, by 2.5 to 5 metres on each side of the waterway, along its full length of 1,208 metres, according to the field visit and the analysis of aerial photographs. In the light of these data, a preliminary estimate of the volume of material deposited on both sides of the artificial canal would be approximately 5,815 m3, although more field data would be required to arrive at a more precise figure. **Annex 2** to this report shows the methodology used to obtain this preliminary calculation of volume of material extracted and deposited during the construction of the artificial canal. This section of the wetland has been left totally destroyed, as it is impossible to restore it to its former status, even if the extracted material could be put back into the artificially-excavated canal.

Figure 13a. *Photograph of 6 April showing the cutoff of a meander to channel the flow of water from the San Juan river to the artificial canal.*

6.1.2 Meander cutoffs

Another aspect to highlight is that, in addition to the works carried out in the Isla Portillos area within Costa Rican territory, the Nicaraguan Government is currently carrying out works in the San Juan river outside the study area, which are altering its geomorphology and hydrodynamics. The direct and indirect impact on the study area will have to be analysed in future to ascertain to what extent these works to redirect the flow of the San Juan river will affect the water flow pattern towards the artificial canal. Although these works are being carried out outside the study area, a brief mention of the matter is included in this technical report.

Based on information available before the visit to the area in April, it had been noted that since November 2010 Nicaragua had been cutting off meanders in its own territory to alter the water flow pattern of the river so that it flowed more easily and faster towards the artificial canal (see Figures 13a, 13b and 13c), thereby transporting more sediments towards the wetland.

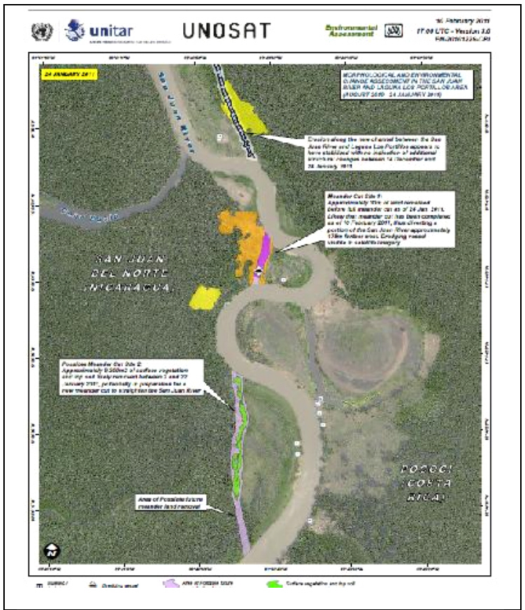

Figure 13b. *Shows the location and progress of work to cut off the meander closest to the beginning of the artificial canal on Isla Portillos.*

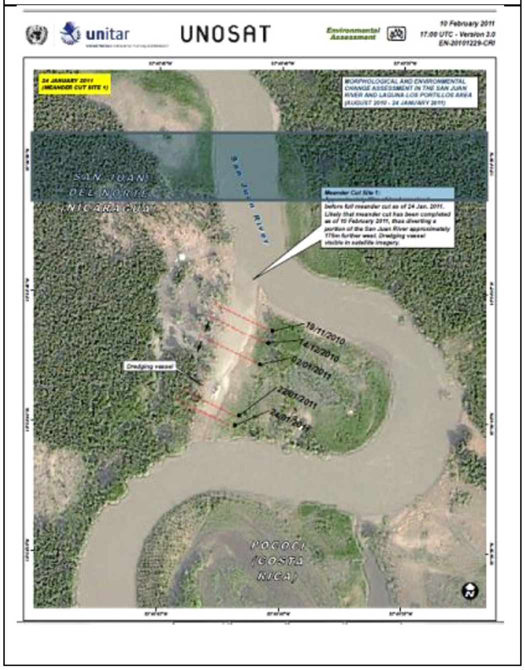

Figure 13c. *Documents progress since commencement of work in November 2010 and its status as at 14 January 2011. Figure 13a above shows the completed work.*

This aspect is important, as each river has its own fluvial characteristics and, as a result, has a unique plant distribution. By cutting off a meander, the length of the watercourse is shortened and hence the energy gradient of the waterway is altered.

This type of artificial change in the geomorphology and hydrodynamics of the river alters its energy balance, bringing about consequent changes in the riverbed, both in upstream and downstream waters, in the speed of flow towards downstream waters, and erosion of banks as a result of increased flow velocity and the realignment of flow direction, which could lead to the creation of conditions that may affect navigation.

6.2 GROUNDWATER

As no information is available on groundwater wells in the study area, the conceptual hydrogeological model was created taking into account the following information:

a. The distribution of main sedimentary sub-environments and the features of their sedimentary facies, including: the main fluvial channel of the San Juan riverbed, the river mouth microdelta which forms part of the north sector of Isla Calero and is covered in the study area, the coastal fluvial plains to the south of the microdelta, the Los Portillos lagoon and the Punta Castilla sandbank (see **Figure 14.a**).
b. The types of sediments that make up each of the sub-environments identified, some of which had been identified directly in the field during the inspection.
c. The distribution of surface water currents and geometry of microwatersheds in the study area, from which it has been possible to deduce the regional direction of groundwater movement.
d. The presence of water springs in some of the sedimentary sub-environments was identified, both during the field inspection and through aerial photographs, which were interpreted and discerned to be the regional groundwater level “spring” within the study area.

Figure 14.b. shows the conceptual hydrogeological model of the study area, following a profile between the San Juan river and the Punta Castilla sandbank and onward to the artificial canal, passing through to the Los Portillos lagoon. As part of this model, the regional groundwater flow directions are established which, as it is present in unconsolidated and surface water materials, follow a similar pattern to that of surface water shown in Figure 14.a.

As can be clearly seen in the image of Figure 14.a., from the right bank of the San Juan river the surface water flow follows a clear and obvious pattern in an E-N-E direction, which also corresponds to the direction of groundwater movement shown in the conceptual model in Figure 14.b.

Figure 14.a shows the location of the artificial canal opened between October 2010 and January 2011. These artificial works not only have an impact on surface water drainage, but also on groundwater drainage which, if a permanent canal is established, could have medium-term effects on the hydrogeological balance and the interface between fresh and salt water in the coastal zone (see Figure 14.b).

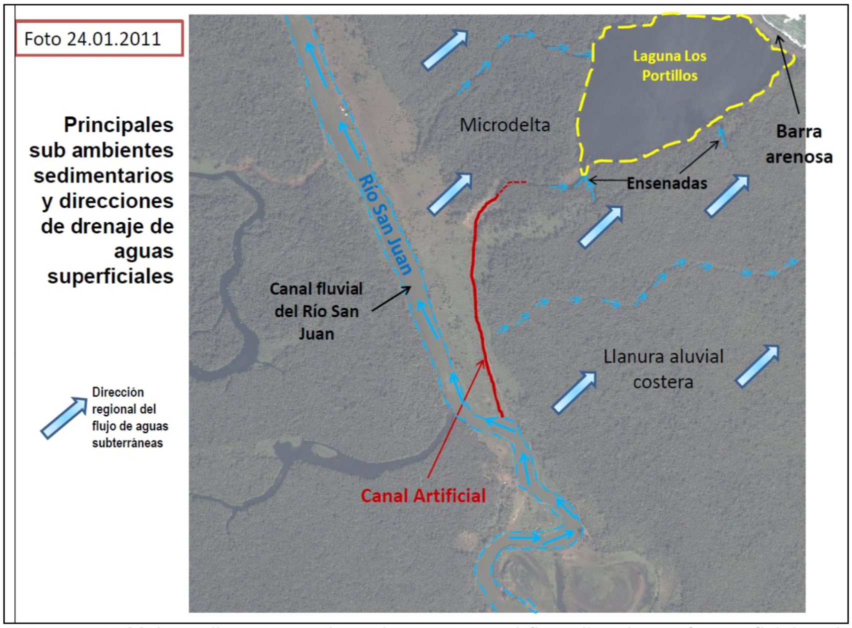

Figure 11. Main sedimentary sub-environments and flow directions of superficial and underground waters

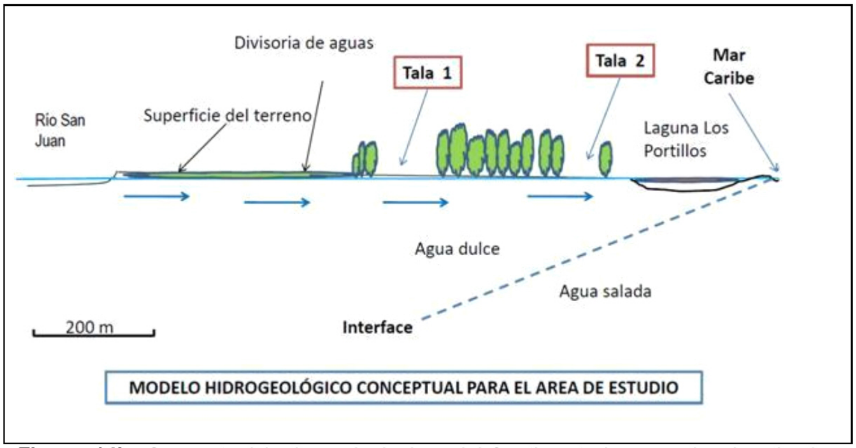

Figure 14b. *Conceptual hydrogeological model for the study area showing the low depth of the local groundwater level, the direction of the regional flow of groundwater and the relative position of the interface between fresh and salt water.*

6.3 SEDIMENTS

In October 2010, an area close to the San Juan river of around 0.24 ha was identified, where approximately 1,680 m^3 of material dredged from the San Juan riverbed was deposited (see **Figure 15**).

No changes were identified in these areas during the inspection carried out on 5 April 2011. The deposit of sediments in this part of the wetland has, however, meant the permanent loss of the ecological conditions existing before the deposit, reason for which it constitutes an irreversible damage.

Figure 15. *Area where sediments from the San Juan river extracted by the Nicaraguans and moved to land on the right bank were deposited and where in addition a work camp was set up during the artificial canal construction works.*

6.4 Flora and Fauna

6.4.1 Ecosystems and wildlife

The site known as Isla Portillos, belonging to the Humedal Caribe Noreste, corresponds to a wetland marsh (Bravo and Windevoxhel, 1997), with hydromorphic soils, classified as entisols, over which evergreen and flooded forest closed formations have developed, whose vegetation is characterized by a dominance of palms called yolillo (*Raphia taedigera*), interspersed with captive wood (*Prioria copaifera*) and other species associated with very humid environments such as sangrillo (*Pterocarpus officinalis*), poponjoche (*Pachira acuatica*), cerillo (*Symphonia globulifera*), gavilan (*Penthacletra macroloba*), jobo (*Spondias mombin),* golden fruit (*Virola koschnyi*), *Montrichardia arborescens,* et al (see **Figure 16**).

Figure 16*. Deforestation process (tree felling) with change in land use. (Photo: J. Bravo, 5 April 2011).*

During the inspection, the presence of aquatic fauna was corroborated, specifically individual species of sardine (banded tetra) (*Astyanax aeneus*), aquatic macroinvertebrates and green kingfisher (*Chloroceryle americana*), and some birds typical of open areas such as tyrant flycatchers (*Tyrannidae*) and groove-billed anis (*Crotophaga sulcirostris*). For more details on the species potentially affected by the works, see the Ramsar Information Sheet on the Humedal Caribe Noreste, point 22, page 11.

As highlighted during the previous visit of the Ramsar Advisory Mission, in December 2010: *"The spatial heterogeneity resulting from salinity gradients (0 <salinity<35 g/L) and residence times of aquatic ecosystems (rivers and lakes) is reflected in a great wealth of aquatic and terrestrial flora and fauna found in the Humedal Caribe Noreste (HCN; Management Plan for the Refugio Nacional de Vida Silvestre, 2010; Management Plan for the Parque Nacional Tortuguero, 2004). With regard to aquatic life, the San Juan River is located in* *the Íctica province of San Juan, where eight families, 25 genera and 54 species of freshwater fish, and at least 84 species of marine fish, are registered."*

The canal recently constructed by Nicaragua is located in an area classified as a fluvial wetland (non-natural). The canal will therefore have an impact on the adjacent sites if the drainage and vegetation clearing activities continue, which would lead to the drying out of soils and the loss of diversity of the existing ecosystem. Furthermore, it would lead to the fragmentation of the habitat and the loss of nesting sites, which would have repercussions on the composition and distribution of species of fauna, mainly involving the species reported in the area which have been declared under threat of extinction or endangered such as Baird's tapir (*Tapirus bairdii*), jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), jaguarondi (*Herpailurus yaguarrondi*), howler monkey (*Alouatta palliate*), capuchin monkey (*Cebus capucinus*) and spider monkey (*Ateles geoffroyi*), three-toed sloth (*Bradypus variegatus*), the harpy eagle (*Harpia harpyja*), lowland paca (*Cuniculus paca*) and great green macaw (*Ara ambiguus*); also 16 species of amphibians and 23 species of reptiles (Ramsar Advisory Mission Report N° 69, 2010, RNVSBC Management Plan, *in press*). The fragmentation of the ecosystem and loss of the nesting site must be considered and recognized as having a significant impact on the species enlisted in the site and which are included in the category of species under threat of extinction.

The impact of bank erosion and the deposit of disaggregated material, characterized by clay and organic material, as a result of waves caused by boats transiting on the San Juan river, specifically in the confluence of the artificial canal and the right bank of the river, is evident. This could cause the local appearance on the site of a floristic composition that does not correspond to species native to flooded environments, and the possible substitution of current flora (**Figure 17**).

Along the artificial canal there is a shallow body of water with deposits of clay-like materials on the banks, probably extracted from the canal. These sediments are dragged to the canal basin by surface rain water runoff (see **Figure 18**).

Figure 17. *Erosion of the banks of the artificial canal and deposit of sediments in the confluence with the San Juan river. (Photo: A. Monge, April 2011).*

Figure 18. *Unconsolidated sediments on the banks of the canal, colonization of herbaceous vegetation and some tree remains (Photo: A. Monge, April 2011)*.

6.4.2 Forestry ecological assessment [3]

Below is a description of the changes observed between the inspections carried out on 25 October 2010 and 5 April 2011, the latter undertaken in conjunction with the Ramsar Technical Mission.

Based on the inspection and taking into account information collected during the inspection of 25 October 2010, it was ascertained that by this date a total of 1.67 ha had been deforested very recently, wherein a total of 197 trees of various species and sizes were counted, with diameters ranging between 5 and 130 cm (Deforestation site 1 in **Figure 2**, see **Figure 19**).

Figure 19. *Partial view of areas of recent deforestation, as observed in the inspection of 25 October 2010. Large pieces of trunk and stumps of over two metres high left after felling activities can be seen.*

By the second inspection on 5 April 2011, which was aided by helicopter flyovers, it was noted that that the deforested areas observed initially had increased by 0.81ha, reaching a total of 2.48 ha of recent deforestation.

[3] Miguel Araya, Forestry Engineer, was responsible for drafting the forestry ecological assessment with the support of Engineer Victor Hugo Montero.

However, these 2.48 ha of primary forest do not make up a single block, but consist of two deforestation fronts; one of approximately 0.48 ha located next to the Los Portillos lagoon (Deforestation site 3 in **Figure 2**, see also **Figure 26**), while the remaining two hectares are located more towards the south-west, approximately 300 metres from the San Juan river (Deforestation sites 1 and 2 in **Figure 2**, see also **Figure 20**).

Figure 20. *Partial panoramic view of the deforested area in the Punta Castilla sector, Isla Calero, taken on 5 April 2011. The deforested area in the bottom right corresponds to part of the area deforested after 25 October of approximately 0.33 ha (Deforestation site 2). The deforestation front located next to the Los Portillos lagoon is out of shot. The San Juan river can be seen in the background. (Photo byAna María Monge)*

Of the two deforested hectares located closer to the San Juan river, 1.67 ha corresponds to the tree felling observed in the first inspection (Deforestation site 1), whereas the remaining 0.33 ha were felled after 25 October 2010 (Deforestation site 2).

Table 2 below shows the distribution of individual trees felled in the 1.67 ha area. It should be noted that while a total of 197 individual trees were counted in October 2010, the data refer to units per area (hectares).

Table 2

Distribution of the number of trees per hectare by category of diameter observed in the 1.67 ha of deforested areas in the Punta Castilla, Isla Calero, Colorado, Pococí and Limón sector.

Scientific name	Number of trees per hectare by category of diameter in centimetres (n/ha)											
	<10	oct-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	90-99	100 >	Total
Casearea sp		0,6										0,6
Ceiba pentandra							1,2					1,2
Unknown		4,8	0,6	0,6	0,6		0,6					7,2
Grias cauliflora		0,6	1,2	0,6								2,4
Inga sp		1,2	0,6									1,8
Lonchocarpus sp		0,6										0,6
Mimosaceae	0,6	2,4	0,6									3,6
Pachira aquatica		3,0	4,8	1,8	1,2			0,6				11,4
Pentaclethra macroloba		0,6			0,6		0,6					1,8
Pterocarpus officinalis		12,6	10,2	6,0	10,8	9,0	13,8	6,0	6,6	2,4	3,0	80,2
Raphia taedigera	Determined by counting stumps in the affected area											42,5
Simira maxonni		0,6	1,2									1,8
Simphonia globulifera		1,2	1,8		1,2							4,2
Spondias Bombin			0,6		0,6							1,2
Overall total	**0,6**	**28,1**	**21,6**	**9,0**	**15,0**	**9,0**	**16,2**	**6,6**	**6,6**	**2,4**	**3,0**	**160,5**

Source: Census carried out on 25 October 2010.

Since during the inspection carried out with the Ramsar Technical Support Mission it was not possible to collect detailed information due to harassment by Nicaraguans, the change in quantity of trees felled per surface area unit was extrapolated from the information shown in the above table, with the help of satellite images. The information obtained can be found in **Table 3**. The data in Table 3 shows that it is estimated that approximately 292 trees had been felled over the whole area. Another important change observed in this area is that during the inspection of October 2010 it had been noted that the felled trees were found complete in the deforested area, observing some partial sectioning of trunks and to a greater extent at branch level, the latter activity being known as branch lopping (see **Figure 21**).

Table 3

Distribution of the number of trees per hectare by category of diameter forecast for the 2.4867 ha of deforested areas in the Punta Castilla, Isla Calero, Colorado, Pococí and Limón sector.

Scientific name	Number of trees per hectare by category of diameter in centimetres (n/ha)											
	<10	10-20	20-30	30-40	40-50	50-60	60-70	70-80	80-90	90-100	100 >	Total
Casearea sp		1,5										1,5
Ceiba pentandra							3,0					3,0
Unknown		11,9	1,5	1,5	1,5		1,5					17,8
Grias cauliflora		1,5	3,0	1,5								6,0
Inga sp		3,0	1,5									4,5
Lonchocarpus sp		1,5										1,5
Mimosaceae	1,5	6,0	1,5									8,9
Pachira aquatica		7,4	11,9	4,5	3,0			1,5				28,2
Pentaclethra macroloba		1,5			1,5		1,5					4,5
Pterocarpus officinalis		31,2	25,2	14,9	26,7	22,3	34,1	14,9	16,3	6,0	7,4	199,0
Raphia taedigera	Determined by counting stumps in the affected area											105,4
Simira maxonni		1,5	3,0									4,5
Simphonia globulifera		3,0	4,5		3,0							10,4
Spondias Bombin			1,5		1,5							3,0
Overall total	1,5	69,8	53,5	22,3	37,2	22,3	40,1	16,3	16,3	6,0	7,4	292,7

Source: Projection from the census carried out on 25 October 2010.

At the time, it was noted that part of the material lopped and cut into sections was being transferred to and stacked at a site close by, located a few metres from the edge of the deforestation area. During the inspection carried out in April 2011, it was observed that, for a sector close to 60 % of the initial deforested area, there had been a total harvesting of the felled trees, to the extent that the stumps initially left untouched were cut and harvested down to ground level.

Figure 21. *Partial view of the area deforested as at 25 October 2010. The clearing of trunks, height of stumps and absence of branches due to their removal can be observed. (Photo by Miguel Araya).*

In this sector the remains of *in situ* sawmilling were observed, which suggests that a significant number of the trunks were sawn up to obtain squared timbers (planks, posts, etc.) which were extracted, as there was no evidence that timber was being stored at the site (see figures 22 and 23).

This new evidence, which was confirmed through the visit carried out on 5 April 2011, leads to the conclusion that, aside from the reasons for carrying out the deforestation, the change brought about by the extraction of the felled timber and its economic harvesting can be assessed not only from the point of view of the ecological services lost, but also from the point of view of the market value of the felled trees, since harvesting clearly took place.

Figure 22. *Partial view of deforested areas as at 25 October 2010, which had been subject to forestry exploitation by 5 April 2011. The absence of trunks can be seen due to sawmilling and the cutting down of stumps to ground level. (Photo by Miguel Araya).*

Figure 23. *Partial view of deforested areas as at 25 October 2010, which show that they had been harvested by 5 April 2011. On the left and right-hand sides can be seen the remains of sawmilling.*

Table 4 shows the percentage of deforested area and other changes observed due to the opening of the artificial canal in the study area.

Table 4

Percentage of deforested area and other changes observed due to the opening of the artificial canal in relation to the total study area.

Changes observed	**Area (ha)**	**Percentage (%)**
Deforested area	2.48	1.1
Undergrowth removal	3.27	1.4
Opening of canal	0.73	0.3
Sediment deposits	0.24	0.1
Total	**6.72**	**2.97**

Source: Field data

Table 4 shows that the total area that suffered a direct impact from the opening of the artificial canal was 6.72 ha, representing approximately 2.97% of the 226.18 ha of the study area.

The opening up of the artificial canal divides the areas of deforestation and undergrowth removal into two, meaning that approximately 0.36 ha of the 2.48 ha of deforested area is located to the south-east of the canal, i.e. on the right bank of the canal. As for the areas of undergrowth removal, 1.51 ha of forest is located to the south-east of the artificial canal.

6.4.3 Estimated deforestation period in the area known as Tala Reciente (Recent Tree Felling)

On 25 October 2010 it was noted that all the individual trees felled in the area known as 'tala reciente' (recent tree felling), which now covers an area of 1.67 ha, were stumps with live bark and cambium. There were sap and open cuts with a high level of humidity perceptible to the touch, and branches with leaves that were still green. All were features pointing to felling having taken place in a period of between one to two weeks before the inspection date.

Subsequently, in April 2011, it was noted that regrowth had occurred on most individual trees left with a stump sticking up at ground level, with an approximate height of between 50-100 cm, consistent with trees that had been cut a little over five months before, which provides further evidence of the period of tree felling observed in inspection of 25 October 2010.

Another indicator to pinpoint the deforestation carried out is the analysis of georeferenced satellite images of the study area, provided by the National Geographic Institute.

Figure 24 compares a satellite image dated 8 August 2010 and another of 19 November 2010, on which was superimposed the perimeter of the area affected by deforestation.

While satellite images were taken periodically until 24 January 2011, most of the deforested areas were already evident on 19 November 2010, although it is possible that after this date other deforestation activities may have been recorded in the affected area.

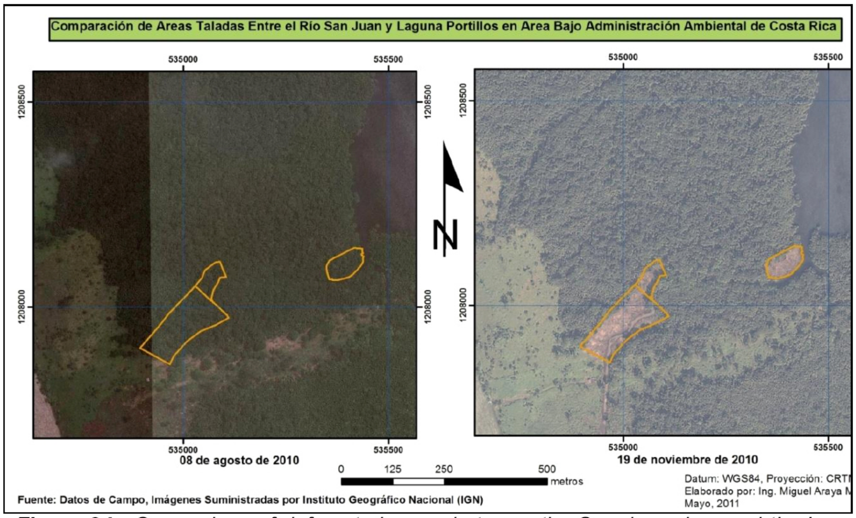

Figure 24. *Comparison of deforested areas between the San Juan river and the Los Portillos lagoon in the Area Under the Environmental Administration of Costa Rica superimposed on satellite images of 8 August 2010 and 19 November 2010.*

Based on field observations and the graphic evidence shown in **Figure 24**, it is stated that the massive felling of trees in the areas known as 'tala reciente' occurred after 8 August 2010.

6.4.4. Removal of Undergrowth

The inspection of 5 April 2011, however, reveals a new fact: although in October 2010 it had been ascertained that the area of undergrowth removal covered a total of 4.08 ha, by April 2011 0.81 ha of that area had already been felled, resulting that by the last inspection the area of undergrowth removal had been reduced to 3.27 ha. In other words, the area of undergrowth removal recorded in the first Ramsar report has diminished, and in equal proportion the primary forest deforestation area has grown, increasing the change brought about to the Humedal Caribe Noreste (see figures 25 to 28).

In October 2010 a pathway of approximately 496 metres in length had been identified plotting a route through areas with no forest. In April 2011, it was observed that this pathway had given way to the artificial canal, which extends for 800 metres through areas with no forest and continues for another 408 metres through the areas known as 'tala reciente' (recent tree felling) and 'socola' (undergrowth removal).

In some sectors stumps of very large and old *Raphia taedigera* (yolillo) and *Pterocarpus officinalis* tree species were observed in the causeway of the canal constructed, which is proof of its artificial nature.

Figure 25. *Partial view of the area with removal of undergrowth, as at 25 October 2010. The removal of small trees and palms as part of the tree felling process can be observed. The prevalent body of water can also be seen. (Photo by Miguel Araya).*

Figure 26. *Panoramic view of the deforestation front located next to the Los Portillos lagoon (Deforestation site 3). The body of water in the deforested areas can be seen, as well as the presence of regrowth. No sawmilling work was observed in this sector. (Photo by Ana María Monge).*

Figures 27a. and 27.b. *On the left, partial view on 25 October 2010 of the pathway cleared to construct the artificial canal, as seen on 5 April 2011, which is shown in the image on the right (left photo Miguel Araya, right photo Ana María Monge).*

Figures 28.a and 28.b. *On the left can be observed the stumps of the Raphia taedigera species in the middle of the constructed canal. On the right can be seen the stump of a Pterocarpus officinalis in the canal channel.*

6.4.5 Former land use in areas with observed changes

From the information collected in the field and the aerial photo evidence, it can be deduced that both the recently deforested areas (2.48 ha) and the areas of undergrowth removal, form part of forest areas well established by 1961, as demonstrated in an image of that date, and that until October 2010 had suffered little or no change to their landscape due to human activity (see **Figure 29**).

With regards to the date of the undergrowth removal, there were indications that the clearing of undergrowth vegetation occurred at the same time as the deforestation of the area observed on 25 October. In these areas most of the small-sized trees (individual trees with diameters of roughly less than 20 cm) and all native bushes with lower canopy coverage had been removed. Given that the area of forest with undergrowth removal and the deforested areas are aligned in a strip of 80-100 metres wide along the artificial canal, it suggests that the undergrowth removal marked a preliminary or preparatory phase for the massive removal of trees to facilitate the construction of the artificial canal.

In addition, in October 2010 an area close to the San Juan river of approximately 0.24 ha was identified, where about 1,680 m3 of material from dredging the bed of the San Juan river was deposited. No changes were noted in these areas during the second inspection carried out.

With respect to the artificial canal and the area of sediment deposits, it is known that prior to their existence the areas where they are located corresponded to areas of tall grasslands. The only exception was a section of approximately 43 % of the length of the artificial canal, which cut through the areas of felled primary forest and cleared undergrowth.

However, the areas covered by tall grasslands have seen visible growth since 1961. **Figure 29** below is a comparison of the area known as Finca Aragón at three different moments by using georeferenced satellite photographs and images provided by the National Geographic Institute.

The first is a photograph dating back to 1961, followed by an aerial photograph of 1997, both compared with an optical satellite image taken on 24 January 2011. The points of comparison and verification are the corresponding coordinate grid CRTM05 and the superimposition of the perimeter of the recently-deforested areas in October 2010.

The 1961 photograph shows that there is a border of only 100 metres wide and approximately 1,500 metres long which extends parallel to the bank of the San Juan river. It is clear that a considerable shadow is cast over the area by the trees and areas of yolillo, which suggests that those areas were originally covered in vegetation native to the area and probably covered in pastures. Perpendicular to this area, approximately in the centre, extends another area sparsely covered with trees or yolillo approximately 90 metres wide by 1,800 metres long, which runs partly along the extreme south-east of the Los Portillos lagoon. The foregoing is a likely predictor of the presence of coconut palms of over 15 metres high in the area with no forest adjacent to the deforested area as at October 2010.

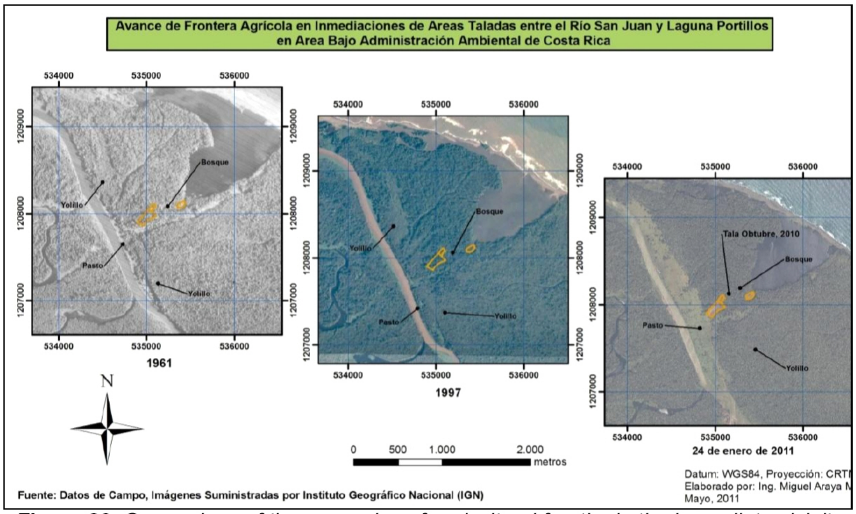

Figure 29. *Comparison of the expansion of agricultural frontier in the immediate vicinity of the deforested areas between the San Juan river and Los Portillos lagoon in the Area Under the Environmental Administration of Costa Rica.*

Contrary to the usual trend of land use change, it can be seen that many of the areas described as sparsely covered by native vegetation in 1961 had recovered by 1997, where areas apparently covered by pastures were limited to narrow strips of barely 80 metres wide and irregular lengths. It can be seen that areas apparently covered by pastures gave way to areas covered by yolillo over a period of 36 years. Such data give an important indicator of the level of resilience of existing ecosystems in those areas.

Despite the tendency observed, it is noteworthy that from 1997 to 2011 (the last 14 years) there has been an expansion of the agricultural frontier to make way for sparsely-forested pastures. Although this aspect is not a direct consequence of the 2010 activities in the wetland, it should be taken into account so as to plan actions for recovery under the general actions to be implemented in the wetland.

7. Ecological implications

Based on the information collected during inspections carried out in October 2010, it was noted that the area of forest affected corresponds to a flooded forest dominated mainly by *Pterocarpus officinalis* (50%), *Raphia taedigera* (26%), Pachira *aquatica* (7%) and *Simphonia globulifera* (3%), which represent 86% of the dominant forest structure of the ecosystem. The remaining 14% is represented by another 10 forest species widely distributed in forest ecosystems with little drainage capacity characteristic of the plains of the North Caribbean of Costa Rica, such as is the case of *Spondias mombin, Pentaclethra macroloba, Simira maxonii* and *Casearea sp.*

Due to the type of existing vegetation and the hydric regime predominant in the area, it can be classified as a freshwater, tree-dominated wetland (Xf) according to the classification system adopted by the Ramsar Convention (Annex 2b to Recommendation 4.7 and Resolution VI.5)

7.1. DESCRIPTION OF THE LIFE HISTORY OF DOMINANT SPECIES

7.1.1 *Pterocarpus officinalis*

This species is classified as being an evergreen leguminous, native to tropical America. It is easily recognized by its large, buttress-shaped roots like narrow plates. It reaches a size of up to approximately 25m high and 130 cm in diameter.

The ecological function of the marshland species *Pterocarpus* resides in the flooded nature of its habitat. Furthermore, it shelters a particular kind of fauna, mainly comprising: reptiles, aquatic birds, amphibians, crustaceans and molluscs. These are areas possessing a wide variety of wildlife.

It prefers lowland areas between 0 and 300 metres above sea level, semi-flooded by running fresh water or periodically flooded, or alluvial banks, with precipitation of 3,400 to 5,000 mm and temperatures above 24ºC.

It can be very common in marshland areas, sometimes forming almost pure stands behind the mangrove line. Fruit is produced in great quantities and frequently cover the marshland waters. In a monospecific forest in Costa Rica 66 adult trees/1000m^2 were recorded, and up to 72 seedlings/m^2. It is found in southern Mexico, throughout Central America, the Antilles, Guyana, Colombia, Ecuador, Venezuela and Brazil.

Seeds are produced in large quantities and during the fruit production season they cover the ground beneath the trees and marshland waters. It has been observed that germination under natural conditions occurs rapidly and the ground is soon covered with seedlings. There are no recorded experiences of seed management or storage.

The species reproduces easily by seed. It has not been used for artificial plantations, hence no reports exist on growing techniques.

In natural conditions, it has been observed that seeds fall at the beginning of December and three months later, in the middle of March, the regenerated seedlings in clearings have an average height of 28 cm. No reports exist on other methods of propagation. Given the facility with which the species sprouts on stumps, growing the species from seedlings would be a distinct possibility.

Within shady marshland grounds, the seeds can germinate on the soil's surface or even float on debris on the surface of shallow flood waters. However, rooting does not occur in water over 3 or 4 cm deep. In areas with periodic flooding, the seedlings can take root when the water level falls and they make contact with the ground surface area.

7.1.2 *Pachira aquatica*

Pachira aquatica is a tree species that produces seeds dispersed by water, distributing them to the edges of bodies of water and reaching sites with diverse environmental conditions.

In the flooded forests of Mexico, plant associations between *Pachira aquatica* and *Symphonia globulifera* have been observed.

Pachira aquatica is a tree that reaches 4 to 30 metres high in its adult state and has a wide canopy. The trunk has a diameter of between 25 and 90 cm, sometimes with the presence of pronounced roots (buttresses), and smooth, grey-to-brownish coloured bark. The leaves have 5 to 9 leaflets, the leaf blade is elliptical or oblong, sometimes lanceolate or slightly obovate, sharp or rounded, and 5 to 28 cm in length. The base of the leaf is mostly recurrent. The leaf is coriaceous or papiraceous in texture, the leaf truss is hairless and the underside finely pubescent with prominent nerves, possessing showy flowers.

It has been noted that *Pachira aquatica* is distributed in coastal plains, in rivers with little marine influence or in brackish lagoons. This species develops best in waters that are entirely fresh.

Pachira aquatica originates from the tropical regions of America and its distribution includes Mexico, Belize and Guatemala to Panama and South America. Its seeds are recalcitrant and can float on the surface of water.

7.1.3 *Raphia taedigera*

This is a tree-like palm with erect stems, which are solitary or multiple (more usual), of between 3 and 12 m high and 25 and 60 cm in diameter, with no spines. It has petioles beyond the pod of between 1.5 and 5 m, with no spines, deeply concave adaxially, with a divided pod.

It has pinnate leaf blades of 5 to10 m, rachis with no spines (except for a simple row of short spines along the adaxil keel) of 95 to 205 small leaves per side, subigual and narrow (0.8 to 6 cm wide), mostly regularly spaced and found at various levels, with transversal veins mostly adaxially, sometimes almost prune-like abaxially and inconspicuously spiny along the edges (especially distally) and in the central adaxial nerve.

It is known that it is a monoic species and its habitat is in marshland forests located in areas with deltaic or marshland coastal regimes typical of lowlands.

The fruits are large, squamous and shiny, which is unique among all the palms of Central America. The plants are surrounded at the base by dense masses of multiple pneumatophores.

The stems have negatively geotrophic adventitious roots among the bases of dead petioles. The "trunks" mainly consist of petiole bases. The floristic composition is associated with areas dominated by yolillo characterized by the presence of species such as *Annona glabra, Ardisia sp., Cecropia peltata, Inga sp., Luehea seemannii, Ocotea sp., Pterocarpus officinalis, Sloanea picapica, Spondias mombin* , et al.

In studies carried out in the areas devastated on the Caribbean coast of Nicaragua in October 1988 by Hurricane Juana, when most of the marshlands damaged by the hurricane were burned and the majority of trees died, among other things the interactions between *Raphia taedigera* and the pioneering fern *Blechnum serrulatum* were studied. Findings were that *Raphia taedigera* achieved rapid growth away from the *Blechnum serrulatum*, which revealed itself to be intolerant to shade, and that *Raphia taedigera* plays an important role in the regeneration of marshland forests.

7.2. ESTIMATED ECOSYSTEM RECOVERY PERIOD

Natural tropical forests cannot in any way be treated as static ecosystems. On the contrary, they have dynamic ecosystems, whose rate of change is dictated by the fall of mature trees, due to the tree's own internal conditions, or induced by anthropogenic or natural external factors, such as forestry exploitation or the action of strong winds, etc.

Tree fall is also the mechanism that opens up the forest canopy to allow new trees to grow, which over time will interact to colonize the clearing and close up the forest canopy.

The time lapse from the opening up of a clearing thus determines the age and maximum dimensions of trees established there. The characteristics of the soil and the climate also determine the structure of the forest, and this structure is the best response of the ecosystem to environmental factors, limitations and threats posed by the surroundings.

Due to the different ecological interactions occurring in a given forest, each one displays a particular behaviour, taking into account the general distribution model of the number of trees per diametric class tending towards an inverted ‘J’ shape whereby, as diameter increases, the number of individual trees decreases (Valerio and Salas, 1998).

The theoretical distribution of the number of trees by category of diameter for disetaneous forests is described by the De Liocourt distribution law (Fredirecksen, et al, 2001).

In **Figure 30**, it can be observed that, as the behaviour of the population viewed (marked circles) responds to a regression model with a high level of adjustment (dotted line), it also coincides with the normal inverted ‘J’ distribution expected for the forest studied.

It can be concluded from those indications that we have to recognize that the deforested area itself responds to a disetaneous distribution of the primary forest.

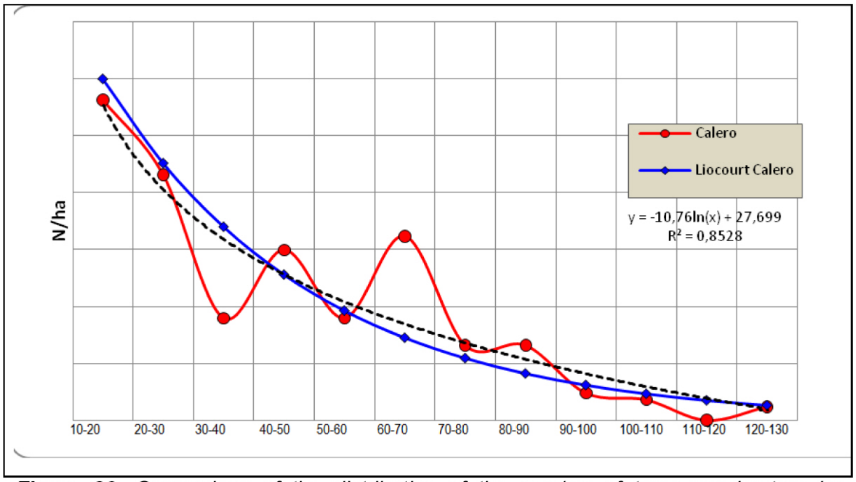

Figure 30. *Comparison of the distribution of the number of trees per hectare by category of diameter observed in the 1.67 ha of deforested areas in the Punta Castilla, Isla Calero, Colorado, Pococí and Limón sector, using the De Liocourt distribution law and a regression model generated from data from the census carried out.*
Source: Census carried out on 25 October 2010

In Costa Rica since the beginning of the 1990s various efforts have been made mainly to find out how the primary forest behaves under forestry management. These efforts have been led by research and education centres such as CATIE, the National University of Costa Rica, the Technology Institute of Costa Rica and nongovernmental organizations such as FUNDECOR and CODEFORSA in the northern area of Costa Rica.

In a study conducted in existing plots of land in the northern area of Costa Rica, it was established that in trees in the diametric class of 30 to 40 centimetres, its diameters grow by 5.1 mm/year, 2.3 mm/year and 1.7 mm/year if they are in a position of emerging, intermediate or suspended treetop respectively. It should be noted that the lifespan of those individual trees in years is 77, 110 and 151 years respectively according to their treetop position.

In the southern area of Costa Rica, Meza, et al, (no date known), in a study called *Edad del Bosque con y sin Manejo en el Trópico Húmedo de Costa Rica* (Age of Managed and Unmanaged Forest in the Tropical Wetland of Costa Rica), determined that for unmanaged forests the annual growth is

6.4 mm/year, whereas in a managed forest annual diametric growth reached 11.7 mm/year.

As a reference point for estimating average diametric growth, a study carried out by Quesada (2003) is used, called *Dinámica del Crecimiento Diamétrico del Bosque Tropical Intervenido de Bajura* (Dynamics of the Diametric Growth of the Lowland Managed Tropical Forest), following the measurement of permanent sample plots in forests located in the area of Boca Tapada de San Carlos, which is very close to the San Juan river. This study ascertains complete lifespan from growth measured for three different management units. It is clear that those forests have been stimulated as a result of interference, contrary to the forest affected, where there is no evidence of previous interference.

Based on the aforementioned study, it is estimated that the current average annual diametric growth is 5.0 mm/year, which, with a statistical confidence level of 95%, would vary between 4.0 mm/year and 6.1 mm/year.

Specifically for the species *Pterocarpus officinalis,* from the information on the permanent sample plot measurements carried out by FUNDECOR to develop the study called *Metodología para el Cálculo de Carbono y CO2 a partir de la Biomasa en los Bosques ubicados en el Área de Interés de Carfix* (Methodology for the calculation of Carbon and CO2 from Biomass in the Forests located in the Area of Interest of Carfix), involving a total of 339 plots located in 37 farms in the North Caribbean region of Costa Rica, it was ascertained that *Pterocarpus officinalis* has an current average growth of 3.5 mm/year. However, minimum average growth was found in the 10-20 cm category, where a current annual growth of 1.5 mm/year was observed, while maximum growth was observed in the diametric categories of 30-40 cm, with 4.4 mm/year.

In light of the above, it can be noted that *Pterocarpus officinalis* grows at a slower rate than the average observed for lowland forests in northern Costa Rica, provided that the data mentioned thus far corresponds to forestry production forests, which would be in a dynamic stage due to the harvesting to which they have been subjected.

With a statistical confidence level of 95%, it is clear that the average growth of all diametric categories for *Pterocarpus officinalis* would vary between 2.9 and 4.2 mm (see **Table 5**).

Table 5
Determination of approximate average, minimum and maximum age in years for the medium diameters of the diametric classes observed in the deforested section in the Punta Castilla, Isla Calero, Colorado, Pococí and Limón sector

Average diametric class (cm)	**Approximate age in years**					
	Average lowland forests in the Northern Area			***Pterocarpus officinalis***		
	Minimum	**Average**	**Maximum**	**Minimum**	**Average**	**Maximum**
15	24,8	29,7	37,2	35,7	42,4	52,2
25	41,3	49,5	62,0	59,4	70,6	87,0
35	57,8	69,3	86,7	83,2	98,9	121,8
45	74,3	89,2	111,5	107,0	127,1	156,6
55	90,8	109,0	136,3	130,7	155,4	191,4
65	107,3	128,8	161,1	154,5	183,6	226,3
75	123,8	148,6	185,9	178,3	211,9	261,1
85	140,3	168,4	210,7	202,0	240,1	295,9
95	156,8	188,2	235,4	225,8	268,4	330,7
105	173,3	208,0	260,2	249,6	296,6	365,5
115	189,8	227,8	285,0	273,3	324,9	400,3
125	206,3	247,6	309,8	297,1	353,1	435,1

It can thus be seen that an individual *Pterocarpus officinalis* of the 50-60 m diametric class might require 183.6 years of age, but with a variance of this period of between 154.5 and 226.3 years, provided that this estimate does not consider the time required to pass from seedling to sapling.

For this reason, if it is considered that the lifespan of individual trees in the 20-30 to 90-100 cm diametric classes is just over 25 years in each category, and that the lifespan for the 10-20 cm category is almost 67 years, it could be generalized that young trees of this species might require at least 25 years to reach sapling size.

Furthermore, the prolonged lifespan required by *Pterocarpus officinalis* to pass from the 10-20 cm category to the next leads to the supposition that the species has a sciofite behaviour during its early stages, and therefore initial canopy protection could be afforded by the *Raphia taedigera* species.

As a timely conclusion, it has been found that there is a weakness in the scenario of natural recovery of the deforested areas, in that the native conditions of these species to reproduce themselves have been affected, especially with respect to *Pterocarpus officilanis*, the species most affected by the deforestation and which requires specific hydric conditions for seed rooting, which are difficult to achieve in the current conditions of the deforested area and it will have to compete with invasory species. Moreover, *Pachira aquatica* is the species that is most vulnerable to the scenario of a possible break in the sandbank if the saline composition of the waters changed.

In the Tortuguero Conservation Area it has been observed that areas of abandoned pastures have formed secondary mature forests with potential for management after 20 to 25 years. However, such a recovery period could not be recommended for the area affected by logging in the Punta Castilla sector in Isla Calero due to the conditions of permanent flooding limiting the entry of colonized species, as the prolonged periods of flooding affect the capacity of seeds to germinate.

Another factor limiting the ecosystem's capacity to regenerate, also having an effect of uncertainty, is the aggressive invasion of pastures, which could serve as a time barrier to the entry of native colonizing species of the ecosystem such as *Raphia taedigera*. This invasion of pastures could also facilitate grazing in adjacent areas, as it might encourage livestock to enter in search of sources food, with the consequent trampling and compacting of the ground, which also encourages the growth of grasses that are known for their aggressive growth.

The aforementioned factors lead to the supposition that the deforested areas in Isla Portillos between the Los Portillos lagoon and the San Juan river might require at least 50 years to become a forest with a similar structure to the eliminated forest with a high canopy dominated by *Pterocarpus officinalis,* with a diameter of around 30 cm, and a medium canopy dominated by *Raphia taedigera*.

The information on growth indicates that to obtain trees with diameters of over a metre would mean waiting at least between 200 and 250 years, during which time there would be no environmental services provided by the deforested trees.

7.3 ASSESSMENT OF THE CHANGE IN ECOLOGICAL CHARACTER

In the Ramsar Advisory Mission Report No. 69 produced in December 2010 for the Wetland of International Importance of the North-eastern Caribbean (Humedal Caribe Noreste), Costa Rica, potential ecological changes were projected under a series of scenarios in the short-term (3-6 months), medium-term (one year) and long-term (five years). The main changes highlighted were:

- Change in the wetland's local groundwater aquifer recharge
- Change in the surface water hydrology
- Soil changes through increased permanent saturation and sediment deposits
- Groundwater geomorphology and hydrology
- Change in water quality due to an increase in volume of fresh water over the estuarine system of the Los Portillos lagoon
- Change in the superficial aquifer quality of the insular wetland due to the influx of water from the San Juan river
- Change in the vegetation cover due to deforestation in the insular wetland
- Change in the growth rate of vegetation species in the insular wetland
- Fragmentation of natural biological corridors in the insular wetland, etc

The interaction of the aforementioned changes and their persistence over time would inevitably generate a series of variations in the ecosystem difficult to predict with precision.

Based on the inspection carried out in April 2011, it was noted that there was no evidence of the continuation of the excavation works on the artificial canal or further deforestation and forestry exploitation in the recently-deforested areas. The recolonization of low bush species was observed, including *Montrichardia arborescens*, which is widely distributed in the various flooded ecosystems of the area. In addition, in the areas bordering the deforested area the presence of invasive grasses (pastures) was observed due to persistent human activities in that sector.

On the section of the artificial canal that crosses the deforestation areas, it was observed that its basin has a higher level of consolidation in relation to the rest of its course.

Due to this sector being deeper than the middle of the canal's course, where erosion of the banks and natural succession probably might interrupt the connection established between the San Juan river and Los Portillos lagoon in the short term, the drainage of flooded pastures, however, might persist for an indefinite time, accelerating and increasing the flow of water from inshore towards the Los Portillos lagoon.

The obstruction with obstacles such as tree trunks and branches in the channel of the artificial canal could contribute in the short term to reducing the flow entering via the artificial canal towards the Los Portillos lagoon.

The Ramsar Advisory Mission Report No. 69 proposes a scenario whereby the hydraulic connection between the San Juan river and the Los Portillos lagoon could be enabled without changing the pattern of surface water runoff and that, in the medium term, by connecting the San Juan river with the lagoon hydraulically by means of the artificial canal, both water flow and sediment transportation will increase and could destroy the sandbank. This could change the behaviour and morphology of the Los Portillos lagoon, which is currently an estuarine lagoon, into a bay with higher salinity. These changes could take place within a hydrological cycle (six to twelve months). On the wetland island, the flood zone might be extended, which will produce fluctuations in level depending on the hydrological dynamics of the San Juan River. This process could increase the water stress on tree and undergrowth vegetation due to flooding, giving rise to a growing halo of dead vegetation, with a loss of habitat for terrestrial fauna.

During the inspection carried out April 2010, the absence of any maintenance work and an incipient loss of hydraulic connectivity between the Los Portillos lagoon and the San Juan river was noted. Despite the possible loss of connectivity between the San Juan river and the Los Portillos lagoon, the existing canal could progressively continue to drain the naturally-flooded areas of tall grasslands. This drainage would in part foster soil support conditions and the entry of species intolerant to flooded areas to the detriment of those normally able to establish themselves in the prevailing environmental conditions.

A possible obstruction on the artificial canal could allow a gradual reduction in the drainage action and enable the re-establishment of wetland conditions on the site at ground level similar to those existing before the construction of the artificial canal.

Based on existing environmental conditions as at October 2010, a change in the ecosystem of unspecified duration is predicted in the long term (five years or more). However, given the conditions observed in April 2011 this picture could change and instead in the long term it could give way to an ecosystem with characteristics similar to those before the deforestation and opening up of the canal, whereby the deforested areas would consist of a natural succession leading to the formation of an area of forest native to flooded ecosystems. However, such a scenario would be conditional on maintaining over time a gradual reduction in the action of the artificial canal, as observed in April 2011.

In the short, medium and long term, the human presence, accompanied by subsistence production activities in the area currently known as the Area Under the Costa Rican Environmental Administration, constitutes a factor that is to the detriment of the recovery of the ecosystem.

Although there are components of the wetland that might recover quickly, other components may be at risk of being lost completely. Furthermore, some sectors of the wetland have already suffered a total impact and will be beyond recovery, such as the areas affected by sediment deposits. To assess whether there are any risks that could lead to a loss of elements of the wetland and the prevailing ecosystems, constant monitoring is necessary. Other measures and assessments are required and should be carried out over the next few months.

8. Conclusions

8.1 General conclusions

Following the visit to the area made on 5 and 6 April 2011, it is possible to conclude that the changes brought about in the Humedal Caribe Noreste have become established. Some of these changes are irreversible.

Moreover, the changes brought about to forest resources are major and more significant than initially thought. An example of this is the age and quantity of felled trees of between 136 and almost 400 years old.

An increase in the deforestation area has been confirmed, following the first notification of tree felling in the area verified on 25 October 2010, and the deforested area has now increased from 1.67 ha to 2.48 ha.

During the second visit, it was noted that felling activities had continued in the area that had previously been affected by undergrowth removal. In addition, there had been the preliminary extraction of approximately 5,815 m^3 of soil and materials from the construction works of the artificial canal between the San Juan river and the Los Portillos lagoon along a trajectory of approximately 1,208 metres.

It was also observed that the construction of the artificial canal will have an impact on the wetland and the hydrological and hydrogeological dynamics, although it is impossible to predict how much at the moment, since it will depend on the hydraulic forces of waters from the San Juan river during periods of intensive rainfall.

Below are the main facts and impacts observed during the visit of 5 April 2011 to the site affected by the invasion, deforestation and construction of the canal, following the main subject areas analysed. With regard to the surface water and groundwater components, it was noted that the hydrogeological situation at the time of the visit was a period of drought, i.e. low water flow in the

San Juan river, relatively low soil humidity, relatively deep groundwater levels and the level of the Los Portillos lagoon was relatively low.

8.2 SURFACE WATER

The following conclusions were made with reference to the subject area of surface water and the sedimentological impact observed in the study area:

1. The visit was carried out during the dry season in the area, hence the flows and fluvial dynamics observed cannot be extrapolated for the rest of year; on the contrary, continuous monitoring of the situation must be maintained throughout the year to assess changes in the hydraulic dynamics under those conditions.
2. Although it was not measured, during the visit a minimal flow in the San Juan river was observed.
3. Surface water runoffs within the delta and the fluvial plains making up the Isla Portillos are minimal.
4. Surface water flow within the artificial canal was under $1m^3/s$.
5. There is a drainage divide located approximately 580 metres distance from the point where the artificial canal begins and the right bank of the San Juan river.
6. The drainage divide separates two mini-basins: one which roughly follows the contours of the Los Portillos lagoon, and the other which forms part of the San Juan river. Within the first mini-basin the surface water runoff is led towards the Los Portillos lagoon; within the second, the runoff is led towards the San Juan river.
7. Under the aforementioned conditions, no hydraulic interconnection between the San Juan river and the Los Portillos lagoon can be verified.
8. The images collected indicate that when the level of water in the San Juan river is high, there is a hydraulic interconnection between the

San Juan river and the Los Portillos lagoon as a result of construction of the artificial canal.

These aspects should be revised in the light of the results of the monitoring programme.

8.3 GROUNDWATER

There is a relationship between the impact caused by the works carried out and the situation concerning the hydrogeological balance of the wetland in the study area. In this respect, the main conclusions are:

1. The groundwater in the area is contained in very shallow aquifer formations with subsoil water flow conditions (atmospheric pressure), abundant in some sectors.
2. The basic conceptual model which can be established is that there is a hydraulic connection of groundwater with the river, the artificial canal, drainage courses and the Los Portillos lagoon.
3. There are local and regional groundwater flow systems.
4. The previously-described drainage divide of the mini-basin may be the result of the local groundwater flow.
5. Given the geometry and hydrological and hydrogeological conditions of the site, the presence of a fresh water/salt water interface can be deduced.
6. The existence of drainage openings or courses, very close and perpendicular to the Los Portillos lagoon, are the result of two factors: a) surface water runoffs on geomorphological depressions; and b) areas with soils of higher permeability that facilitate the connection between groundwater and the lagoon.
7. The impact of the extraordinary connection between the river and the lagoon may induce changes in the hydrogeological balance of the system, in particular in the fresh water and salt water interface, an aspect that requires further follow-up investigations.

8.4 SEDIMENTS AND EXTRACTED MATERIALS

The main conclusions on this subject area are as follows:

1. According to the data obtained during the visit of April 2011 and the dimensions of the artificial canal, it can be concluded that, although there is no bathymetry of the artificial canal and the observations are preliminary in nature, its construction might have generated approximately 5,815 m^3 of extracted materials, which were deposited on both sides of the canal.
2. These materials created an instable sedimentary filling on both banks, which could be eroded by fluvial action and precipitation. The transport of those materials via the artificial canal is regulated by the direction and magnitude of surface water runoffs, even enabling them to be transported towards the San Juan river.
3. In October 2010 an area close to the San Juan river had been identified of around 0.24 ha in which was deposited approximately 1,680 m^3 of material dredged from the bed of the San Juan river. No changes were identified on these areas during the inspection carried out on 5 April 2011. Sediment deposits on that part of the wetland, however, have led to the permanent loss of the ecological conditions existing before the deposits.

8.5 FLORA AND FAUNA (ECOLOGICAL ASPECTS)

The main conclusions with respect to the ecological aspects of the study area are:

1. The removal of undergrowth and forest was observed in the sectors defined as Tala1 (deforestation area 1), Tala 2 (deforestation area 2)

and Tala 3 (deforestation area 3). It was noted that the deforestation areas initially observed in October 2010, were increased by 0.81ha, reaching a total of 2.48 ha of deforestation. The tree felling occurred in two primary forest fronts; one of approximately 0.48 ha located next to the Los Portillos lagoon, and the remaining 2 ha to the south-west, approximately 300 metres from the San Juan river.

2. During the visit no felled trees were observed in the study area, but recent evidence was found of sawn timber.
3. A reduction of the area subjected to 'socola' (undergrowth removal) observed in October 2010 was clearly visible, as that area, estimated to cover 4.08 ha at the time, now amounts to 3.27 ha. The difference is due to the proportional increase in the deforested area.
4. A total of 197 felled trees had been counted in Tala 1 (deforestation area 1) in a census carried out on 25 October 2010, whose area is 1.67 ha. As it had not been possible to collect detailed information in the inspection carried out on 5 April 2011, due to harassment by Nicaraguans, the change in quantity of trees felled per surface area unit was extrapolated with the help of satellite images for the area that also includes areas Tala 2 (deforestation area 2) and Tala 3 (deforestation area 3), with a total area of 2.48 ha of deforestation. Applying this method, the preliminary estimation of the number of felled trees is around 292, although a new census should be carried out in future in the study area.
5. It was noted that most felled trees were from the species *Pterocarpus officinalis.* The recovery of this forest species is subject to a complex and dynamic process and interaction with other species, which could compromise its reproductive capacity in the affected area. No experience of reproduction through seed or seedling management exists for this species.
6. The second most affected species by the illegal deforestation carried out in the primary forest of the Humedal Caribe Noreste is *Raphia taedigera*.

7. The other species majorly affected by the deforestation is *Pachira aquatica*. It is a very vulnerable species because it is intolerant to brackish water.
8. No dead individual terrestrial fauna were observed.
9. Very few terrestrial fauna were seen in the area defined by the artificial canal and the area cleared of vegetation.
10. Fish and aquatic invertebrates were observed in the artificial canal.

8.6 ENVIRONMENTAL IMPACTS

The main conclusions on this subject area are as follows:

1. The construction of the artificial canal and the removal of vegetation in sectors Tala 1, Tala 2 and Tala 3 have resulted in the partial fragmentation of the habitat.
2. The life history of the species of felled trees enables the alteration to be categorized as negative and irreversible on a level at which the environmental impacts can be gauged with certainty.
3. As the study area corresponds to a geographical space under special administration, in that it corresponds to a protected wetland established as a Ramsar site, the fact that there have been activities to change land use involving removal of the natural vegetation cover and changes have occurred in the local ecological balance, constitutes a significant negative environmental impact.
4. The significant negative environmental impact is clearly evident in the terrestrial flora and vegetation. In the case of the negative environmental impact on surface water and groundwater, further studies to ascertain more precisely its level of significance are needed. Similarly, the potential negative impact on the soil can be considered, although further studies are also needed to judge their significance.

5. Through the current study, environmental impacts within the study area have been quantified and qualified, in particular on vegetation, and other impacts on soils and fauna of the study area have been defined qualitatively. It was noted that potentially an impact chain could have been initiated, which would last over time and could continue generating negative impacts within the study area, thus maintaining a situation of ecological unbalance in the part of the wetland affected, although future actions to determine these aspects would be required.

8.7 Final conclusion

The inspection demonstrated that some changes have been incurred in the Humedal Caribe Noreste, which are now irreversible or irreparable, such as the loss of the forest, the loss of the ecosystem in the places influenced by the human action that took place in October 2010, the dumping of sediments and materials from both the dredging works on the San Juan river and the construction of the artificial canal.

On the inspection date, carried out in the dry season, it had not been possible to establish the highest volume of water from the San Juan river that might pass through the artificially-constructed canal, hence monitoring of the artificial canal and its surroundings should be maintained. If the volume of water from the San Juan river remains constant and reaches the Los Portillos lagoon, it could cause irreversible changes in the lagoon and the terrestrial ecosystems attached to the lagoon. This would also have repercussions and could bring about irreparable changes to vegetation and animal species coexisting in the ecosystem.

This report in itself is not exhaustive, but enables the establishment of a basic criterion on the conditions of the wetland. It must be followed up by a comprehensive work plan, which envisages continued work on assessments, measurements and observations to help establish actions to recover the parts of the wetland that may be capable of recovery. Not carrying out constant monitoring and surveillance would have the consequence of failing to take actions that would prevent permanent, irreparable damage to the wetland.

9. Recommendations

9.1 RECOMMENDATIONS BASED ON RESULTS OBTAINED TO DATE

In the light of the results of the evaluation carried out so far, the main recommendations to implement are as follows:

1. No more interference must be allowed in the deforested area to ensure that natural regeneration processes can take place, where they can take place, given that there are areas that will be unable to regenerate. However, it is not excluded that, if circumstances so recommend, specific actions that will help the natural regeneration of the area will be taken.
2. To establish a continuous monitoring and surveillance campaign to keep up to date with the changes on the baseline data of indicator species for three or more years so as to measure developments in the study area.
3. To include in a georeferenced system that allows monitoring with a six-month periodicity, over a period of three years, signs of renovation of the ecosystems affected from the transect demarcated in the field and which covers both the deforested area and adjacent areas.
4. To promote the natural recovery of the deforested and undergrowth removal sites, for which constant monitoring by professional technical staff from the Tortuguero Conservation Area would be required to support the restoration process, as well as preventing activities leading to a land use change in the border area protected under Executive Decree No 22962, which declares the area 2,000 m wide along the border with Nicaragua from Punta Castilla in the Caribbean Sea to Bahía Salinas in the Pacific Ocean as the Refugio de Vida Silvestre del Corredor Fronterizo (Border Corridor Wildlife Refuge).
5. To allow the closing of the artificial canal as soon as possible to prevent the drainage of the wetland forest, the impact on the aquatic ecosystems

of the Los Portillos lagoon, the impacts on the ecosystems dependent on the lagoon and reduce the impact chain that may lead to the possible rupture of the sandbank of the Punta Castilla coastline. How the closing up of the canal can be effected remains a subject of the recommendations made on the matter by the Ramsar Convention Secretariat.

6. To request information from Nicaragua on the discharge and velocity curves of the waters of the San Juan river in order to assess the impact of the meander cutoffs, since in areas where differences in level are minimal cutting off meanders has an impact on the whole balance of the river.
7. To define a set of sequential actions and priorities for the recovery of the wetland, which includes aspects such as the recovery of the hydric system balance, re-establishing vegetation and the static design to maintain succession and promote recovery of the habitat, which is conducive to endangered fauna and which may be affected by the fragmentation of the habitat.
8. Financing will need to be obtained to carry out timely studies and assess the capacity of hydraulic dampening, and the impact of the works carried out in groundwater recharge capacity.
9. Restoration activities should be undertaken on the environmental functions and values of the Humedal Caribe Noreste to ensure its original ecological characteristics prevail, which entails carrying out careful research into the interaction of the deforested species with the species of flora and fauna endangered or at risk.
10. To define a Costa Rican inter-institutional articulation framework, where policies, strategies and resources can be coordinated, and to share relevant technical and scientific information for the recovery of the HCN.

9.2 FOLLOW-UP WORK AND RECOMMENDED WORK PLAN

As part of the tasks to consolidate the research carried out and as part of the environmental diagnosis of the study area, the following actions are recommended:

1. To continue the assessment of the impact of the works undertaken, the impact chains initiated, their short-term, medium-term and long-term implications, and to further develop the environmental, preventive, corrective, mitigating or compensatory measures that must be implemented to restore the natural environmental balance of the site and thus prevent more changes to the wetland.
2. To promote research and carrying out a census of aquatic nesting birds.
3. To draw the precise cartography of the distribution of communities of vegetation of special protection and endangered species of flora in the Humedal Caribe Noreste.
4. To systematize existing data on the habitats and species which are the subject of special protection and to draw maps. This information must be updated at least every three years.
5. To carry out a study on the evolution of hydric regimes and water quality.
6. To conduct a hydrographic study and further develop hydrological modelling of the study area.

Annex 3 to this report shows a detailed schedule of the actions that the Government of Costa Rica aims to complete during the period 2011-2015 to undertake the aforementioned activities.

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Work team

NAME	ACADEMIC QUALIFICATIONS AND DISCIPLINE	INSTITUTION
Miguel Ángel Araya Montero	University degree in Forestry Engineering and degree in Management and Protection of Natural Resources	Tortuguero Conservation Area SINAC-MINAET
Allan Astorga Gättgens	Degree in Geology, Doctorate in Natural Sciences, specialist in Sedimentology and Environmental Assessment	University of Costa Rica
Federico Avilés Chacón	Civil Engineer, Masters in Hydrology	Costa Rican Institute of Electricity
Juan Bravo Chacón	Geography, specialist in wetland restoration, ecology and environmental education	National University of Costa Rica
Jorge Gamboa Elizondo	Specialist in Management and Protection of Natural Resources	National Wetlands Programme, Executive Secretariat of SINAC-MINAT
Mariana Jimenez Arce	Geography, specialist in Geographical Information Systems	Tortuguero Conservation Area SINAC-MINAET
Sadí Laporte	Degree in Meteorology with postgraduate qualification in Hydrology	Costa Rican Institute of Electricity
Ana María Monge Ortiz	Biology, specialist in Ecology	Tortuguero Conservation Area SINAC-MINAET
Victor Hugo Montero Navarro	Degree in Forestry Engineering	Tortuguero Conservation Area SINAC-MINAET
Jairo Sancho Murillo	Biology, specialist in Management of Protected Areas	Executive Secretariat of SINAC
Renato Sánchez González	Degree in law	Cordillera Volcánica Central Conservation Area SINAC-MINAET

NAME	ACADEMIC QUALIFICATIONS AND DISCIPLINE	INSTITUTION
Luis Alberto Rojas Bolaños	Administration of Conservation Areas, Doctor in Education and Degree in Sociology	Director, Tortuguero Conservation Area SINAC-MINAET
Luis Diego Román Madríz	Planning and logistics	National Fire Programme, Executive Secretariat of SINAC-MINAT

ANNEX 1:

Information sheet on the Sector Isla Portillos of the Study Area of the Humedal Caribe Noreste of Costa Rica

It has a warm climate, very humid. According to Holdridge, it falls within a pre-mountain rainforest transition to basal. It is influenced by marine action, which has filled its base layer with fine sand on top of which are thin layers formed of clay, silt, and organic material which makes up the soil, and it is also influenced by the hydroclimatic conditions of the Caribbean region. Vegetation typical of flooded forests predominates, dominated exclusively by Yolillo, and in the most external parts Royal Palm is mixed in with other woody species. Wildlife may include felines, tapirs, deer, goats, lizards and iguanas.

LOCATION

Province:	Limón
Canton:	Pococí
District:	Colorado

QUADRANGLE MAP:	Punta Castilla
Latitude:	10º 55´ 30"
Longitude:	85º 07´ 00"
Surface area of the wetland:	225 hectares

TEMPERATURE (°C)

Maximum:	30°
Median:	28°
Minimum:	26°

SALINITY

Brackish water: approx. 10ppmil. Variable range: 0,1-10 ppmil.

Main rivers: San Juan River.

Access routes to the Study Area: By sea, San Juan river and walking from the mouth of the Agua Dulce lagoon or the Pereira lagoon, and via the beach.

Type of Wetland:
Dominant wetland: marshland system, subsystem: flooded forest
Associated wetland: riparian system
Landscape classification: forest marshlands

Relevant vegetation of the ecosystem:

Dominant species: *Pterocarpus officinalis* (sangrillo), Poaceae*: Paspalum sp*. (gamalote); Arecaceae*: Raphia taedigera* (yolillo).

Associated species: Rhizophoraceae: *Rhizophora* sp. (mangle); Fabaceae: *Prioria copaifera* (captive); Papilionoideae: Dipteryx *panamensis* (almendro); Mimosoideae: Pentaclethra macroloba (gavilan).

Features of existing fauna:

Representative species: Fish: Carcharhinidae: *Cacharhinus sp.* (shark); Haemulidae: *Pomadasys sp*. (Burro grunt); Centropomidae: *Centropomus undecimalis* (common snook); *C. pectinatus* (tarpon snook); *C. paralellus* (fat snook); Gerreidae: *Diapterus so.* (snapper); Megalopidae: *Tarpon atlanticus* (tarpon); Soleidae: *Trinectes paulistanus* (slipper sole); Lepisosteidae: *Atractosteus tropicus* (tropical gar). Reptiles: Emydidae: (*Rhinoclemmys sp*. (river turtle). Mammals: Felidae: *Phantera onca* (jaguar); *Leopardus pardalis* (ocelot); Tayassuidae: *Tayassu pecari* (white-lipped peccary); Tapiridae: *Tapirus bairdii* (Baird's tapir); Trichechidae: *Trichechus manatus* (West Indian manatee). Birds: Ardeidae: *Egretta sp.* (egret); Accipitridae: *Buteogallus anthracinus* (common black hawk); Pandionidae: *Pandion haliaetus* (osprey); *Ara ambiguus* (great green macaw).

Endangered species:

Species	Status according to IUCN	Status according to MINAE	CITES
Amphibians			
Caecilians			
Gymnopis multiplicata		Reduced population	
Salamanders			
Bolitoglossa colonnea		Reduced population	
Oedipina cyclocauda		Reduced population	
Oedipina gracilis	Endangered		
Frogs and toads			
Bufo melanochlorus		Reduced population	
Dendrobates auratus		Reduced population	Appendix II
Dendrobates pumillo		Reduced population	Appendix II
Phyllobates lugubris		Reduced population	Appendix II
Agalychnis calcarifer		Reduced population	
Agalychnis saltator	Near Threatened	Reduced population	
Smilisca puma	Vulnerable		
Eleutherodactylus mimus		Reduced population	
Eleutherodactylus noblei		Reduced population	
Eleutherodactylus ranoides	Critically Endangered		
Eleutherodactylus altae	Vulnerable	Reduced population	
Rana warszewitschii	Near Threatened		
Reptiles			
Lizards			
Iguana iguana			Appendix II
Thecadactylus rapicauda		Reduced population	
Dactyloa frenata		Reduced population	
Norops lemurinus		Reduced population	
Norops carpenteri		Reduced population	
Norops pentaprion		Reduced population	
Polychrus gutturosus		Reduced population	
Snakes			
Boa constrictor		Under threat of extinction	Appendix I
Corallus annulatus		Reduced population	
Ungaliophis panamensis		Reduced population	
Clelia clelia		Reduced population	Appendix II
Micrurus nigrocinctus			Appendix III
Turtles			
Kinosternon angustipons	Vulnerable	Reduced population	
Chelydra serpentina		Reduced population	
Dermochelys coriacea	Critically Endangered	Under threat of extinction	Appendix I
Caretta caretta	Endangered	Under threat of extinction	Appendix I
Chelonia mydas	Endangered	Under threat of extinction	Appendix I
Eretmochelys imbricata	Critically Endangered	Under threat of extinction	Appendix I
Chrysemys ornata	Near Threatened		
Rhinoclemmys annulata	Near Threatened		
Rhinoclemmys funerea	Near Threatened		
Crocodiles			
Caiman crocodilos		Reduced population	Appendix II
Crocodylus acutus	Vulnerable	Under threat of extinction	Appendix I

Species of commercial value: Fish: Centropomidae; Pomadasydae, Charcharinidae (sharks), Lutjanidae (snappers), Caranjidae (horse mackerel), Characidae (sabaletes)

Legal situation of the Wetland area:
Management category: it is part of the Refugio Nacional de Vida Silvestre Corredor Fronterizo (Border Corridor National Wildlife Refuge).

Institution responsible for management: Refugio Nacional de Vida Silvestre Barra del Colorado (REBACO) (Barra del Colorado National Wildlife Refuge), Tortuguero Conservation Area (ACTo), National System of Conservation Areas (SINAC), under the auspices of the Ministry of Environment, Energy and Telecommunications (MINAET).

Level of protection attained: Deficient, due to a lack of staff.

Management situation: There is no Management Plan.

Communities neighbouring the site:
The wetland neighbours the communities of Barra del Colorado, Jobo and the Delta of Costa Rica, and San Juan in Nicaragua.

Main economic activities: agriculture, livestock rearing, small-scale fishing.

Traditional practices carried out in the Wetland: fishing, livestock rearing and subsistence farming.

Main economic activities in the area of influence of the Wetland:
Small-scale fishing, leisure fishing, tourism, livestock rearing, and subsistence farming.

List of public and private actors
Tortuguero Conservation Area, Public Force, National Coast Guard Service, Municipality of Pococí, Institute of Fishing and Aquaculture, Ministry of Health, National Institute for Vocational Training, State Distance University, University of Costa Rica, Administrative Board for the Development of the Atlantic Coast.

BENEFITS

Fisheries
Protection against floods and storms
Capture of sediments
Protection of the coastline
Retention of sediments and nutrients
Recreational opportunities
Transport
Tourism
Cultural value
Environmental services

DISTURBANCES

Agriculture
Expansion of the agricultural frontier
Pollution
Overexploitation of wildlife resources
Deforestation
Drainage of wetlands

THREATS

Agriculture
Expansion of the agricultural frontier
Pollution
Overexploitation of wildlife resources

ANNEX 2:

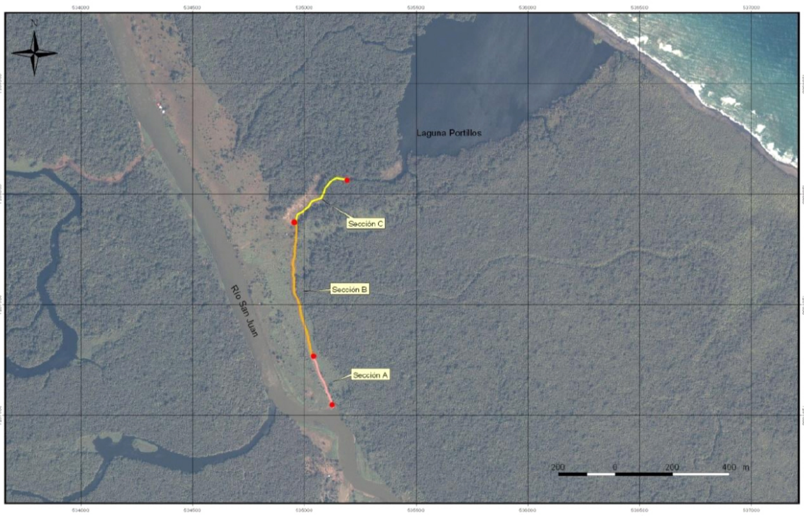
Estimate of the quantity of sediment extracted from the artificial canal

Based on the information collected in the field on 5 April 2011, a preliminary estimate was made of the volume of material extracted when excavating the artificial canal. For this purpose, the data collected on 5 April 2011 in three measurement sites on the artificial canal were used (see Table 1 and Map 1).

Table 1
Preliminary estimate of the volume of material extracted for the excavation of the artificial canal in the study area

SECTION	Depth of the canal (m)	Width of the canal	Length of the canal	VOLUME
A	1.25 m	5.30 m	248.824m	1648 m^3
B	0.6 m	4.20 m	627.817m	1582 m^3
C	1.5 m	5.20 m	331.406m	2585 m^3
TOTAL VOLUME EXTRACTED				**5815** m^3

Map 1
Estimate of sediments in sections A, B and C



ANNEX 3:

WORK PLAN, Isla Calero, Humedal CARIBE NORESTE-COSTA RICA 2011-2015

ACTIVITY	DESCRIPTION	Period of execution																			
		Year																			
		2011				2012				2013				2014				2015			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1.Assessment and monitoring of the natural regeneration process in the forestry ecosystem interfered with	Creation of baseline for monitoring the regeneration of forest ecosystem interfered with																				
1.1 Visit to the site to assess current condition, definition and marking out transects for assessment and monitoring	Location of two transects to carry out monitoring. The first transect will extend to 450 linear metres, of which: 150 metres will be in the untouched forest, 150 metres in the deforested area and 150 metres in the area of forest where only undergrowth removal took place. The second transect will be located on the artificial canal, beginning at its connection with the San Juan river, extending to 300 metres in a straight line. The aspects to be measured will be: -To establish percentage level of cover every 25 metres. -Count number and measure dimensions of forest species																				

ACTIVITY	DESCRIPTION	Period of execution																			
		Year																			
		2011				2012				2013				2014				2015			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
	every 5 metres. -Identification of species of flora and fauna in the untouched forest, the deforested area and the sector with undergrowth removal.																				
1.2 Design of assessment and monitoring strategy	A basic strategy will be defined which will be adjusted in line with results to ensure the quality of data.																				
1.3 Monitoring	Monitoring will be carried out every 3 months.																				
1.4 Systemization and assessment of results	By 2013 to measure progress in the regeneration process, to revise methodology and evaluate changes or adjustments in the monitoring strategy. By 2015 assessment II of progress in regeneration.																				
1.5 Identification of barriers to the regeneration process	Establishment of possible biophysical and socioeconomic barriers.																				
2. Collection of seeds of predominant forest species	Aim to collect propagation material of predominant forest species such as *Pterocarpus officinalis, Penthacletra macroloba, Spondias mombin, Virola koschnyi*, in order to establish a seed nursery, which will enable reforestation of the deforestation or sediment deposit sites, at a time when conditions will be optimal for growing species.																				
3. Monitoring of the state of the artificial canal:	Creation of a baseline for monitoring restoration of the site where the artificial canal was built.																				
3.1 Location of a transect with three	The three measurement sites will be located: - One at the entrance of the San Juan river to the canal. The second 300 m going up to the Tala 1 (deforestation																				

ACTIVITY	DESCRIPTION	Period of execution																			
		Year																			
		2011				2012				2013				2014				2015			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
measurement sites	area 1) site, from the point of entrance of the San Juan river to the artificial canal. The third in the site where the artificial canal unites with the waters from the Los Portillos lagoon. At these three sites will be measured: • Levels of sedimentation • Water flows • PH of the water • Salinity levels • Icthyofauna • Vegetation																				
3.1 Identification of barriers to the regeneration process of the canal site	Establishment of possible biophysical and socioeconomic barriers for the area located along the artificial canal.																				
4. Assessment of hydric regimes and water quality	Included as part of these works is drawing up a detailed topographical map of the study area and its immediate surrounding area, based on recent aerial photographs and field verification																				
4.1 Monitoring of the condition of surface water and groundwater hydric communication between the San Juan river and the Los Portillos lagoon within the	Following a seasonal observation pattern in line with the flood regime of the river: • Preparation of measurement sites • Establishment of water level recording stations in the artificial canal • To correlate water levels in the artificial canal with water levels of the Colorado river. • To schedule a periodic measurement campaign of water flow in the artificial canal • To monitor water flows in San Juan river • To measure hydraulic depth of San Juan river																				

ACTIVITY	DESCRIPTION	Period of execution																			
		Year																			
		2011				2012				2013				2014				2015			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
Study Area	close to the beginning of the channel • To measure the hydraulic depth of the Los Portillos lagoon • To set up a meteorological station on Isla Calero • To construct a quantitative hydrological model of the San Juan river which includes runoff and sediment transport data • To set up one or more piezometers on Isla Calero with automatic measurement sensors • With the model constructed, propose several runoff and sediment transport scenarios • To take geophysical measurements to define the fresh water/salt water interface																				
4.2 Drawing up of detailed topographical map of the study area and its immediate surrounding area and bathymetric and hydraulic definition of the artificial canal	• Aerial photograph • Satellite images • Contour lines 50cm or less • Cross sections every 50 m • To draw a longitudinal section of the bottom of the channel • Determination of the bathymetric and hydraulic characteristics of the artificial canal • To reference data collection at known geodetic level benchmarks																				
4,2 Establishment and monitoring of conceptual hydrogeological model for the study area and its immediate surroundings	To try to establish more precisely the condition of the fresh water/salt water interface and the consequent impacts of the hydric communication generated by the development of the artificial canal. As part of the consideration process, to carry out stratigraphic surveys, set up piezometers and to map facies in order to develop a 3D model of the geological-sedimentological system of the study area. The surveys and mapping must be carried out during the first year. During the second year, monitoring work will be																				

ACTIVITY	DESCRIPTION	Period of execution																			
		Year																			
		2011				2012				2013				2014				2015			
		I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
	undertaken.																				
5. Monitoring of water quality and assessment of sediment movements	To carry out comparative and time control analyses: • Water quality changes • Transportation of suspended and dredged sediments • Grain sizes																				
5.1 Periodic monitoring of water quality of surface water and groundwater in the study area	To try to determine the variations and linkages of the surface water and groundwater hydric system of the study area. Sampling will be carried out every four months																				
5.2 Monitoring and analysis of sediment movements in the study area	The transfer of sediments towards the Los Portillos lagoon during flood periods of the San Juan river																				

Annex 156

Note from the Permanent representative of Costa Rica to the UN in Geneva, to the Secretary General of the RAMSAR Convention on Wetlands, Ref: MPCR-ONUG/2011-722,

28 October 2011

TRANSLATION

(Seal)

Permanent Mission

of Costa Rica

Geneva

Geneva, Switzerland

28 October 2011

Mr.
Anada Tiega
Secretary General
Convention on Wetlands of International Importance
Gland, Switzerland

Dear Mr. Secretary General,

The Government of the Republic of Costa Rica is pleased to present to the Secretariat of the Ramsar Convention the technical report prepared by the Costa Rican personnel responsible of Environmental Protection, which is mainly the result of the inspection made jointly between those responsible and the technical delegation from the Secretariat of the Ramsar Convention for that purpose, and held on 5 and April 6, 2011, and in which other information related to the situation of the northern are of the Humedal Caribe Noreste has been assessed.

This report makes a preliminary assessment of the status of the wetland. More information is required to be collected *in situ*, in order to more accurately detail the evolution of the wetland, and in particular, take the actions necessary to avoid irreparable damage in addition to the one already suffered by it [the wetland]. As the Secretariat is aware, the mission of last April was subject of harassment by Nicaraguan nationals, which prevented the proper development of the evaluation work.

The referral of this report and the actions that are proposed is made as a consultation to the Secretariat of the Ramsar Convention and within the framework of the Order indicating Provisional Measures, issued by the International Court of Justice on 8 March 2011.

The Government of Costa Rica would be grateful to have the opinion of the Secretariat on the report as soon as possible, in order to initiate the implementation of the actions contained therein.

Please accept, Mr. Secretary General, the assurances of my highest consideration,

Manuel B. Dengo Benavides

Ambassador, Permanent Representative of Costa Rica

(Seal)

Ref. MPCR-ONUG72011-722

Arch./14.4.1

Annex 157

Aguilar-González, B. et. al. 2011 "A summary of Actual and Potential Environmental Service Losses Due to the Current Ecological Conflict in the Portillos/Calero Island Region in the Caribe Noreste Wetland in Northeastern Costa Rica", San José, Costa Rica: Fundación Neotrópica.

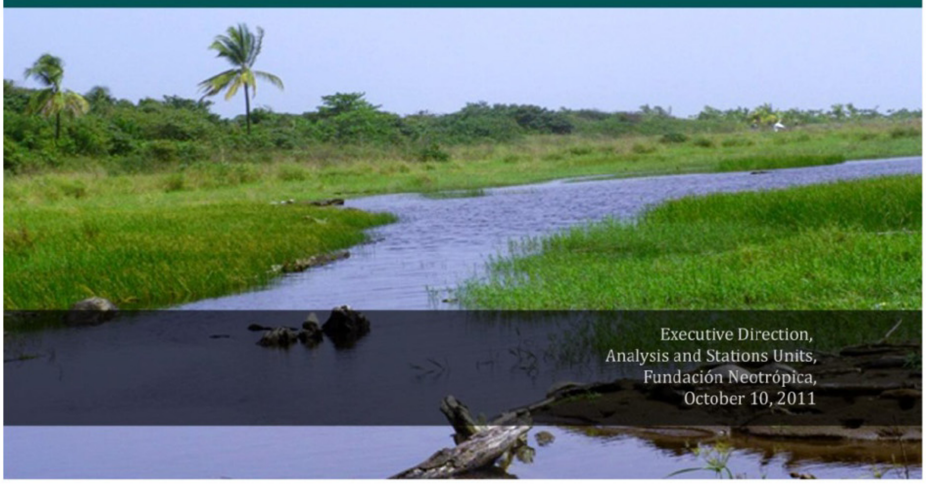
10 October 2011

FUNDACION NEOTROPICA

A Summary of **Actual and Potential Environmental Service Losses**

Due to the Current **Ecological Conflict** in the **Portillos/Calero Island Region** in the

Caribe Noreste Wetland in Northeastern Costa Rica.



Aguilar-González, B. et. al. 2011. ***A Summary of Actual and Potential Environmental Service Losses Due to the Current Ecological Conflict in the Portillos/Calero Island Region in the Caribe Noreste Wetland in Northeastern Costa Rica***. San José, Costa Rica: Fundación Neotrópica, 36 pp.

Cover design by Karla Córdoba, Communications and Corporate Outreach Coordinator, Fundación Neotrópica, kcordoba@neotropica.org .

Technical Team:

Bernardo Aguilar-González[1],

Azur Moulaert-Quirós[2],

José Oduber Rivera[3],

Lorena Erbure[4],

Alexander González[5],

Ligia Umaña-Ledezma[6],

Marco Hidalgo-Chaverri[7].

[1] Corresponding author: Ecological Economist and Environmental Attorney, Executive Director-Fundación Neotrópica, San José, Costa Rica, baguilar@neotropica.org ; [2] Forest Engineer, Research Fellow-Gund Institute for Ecological Economics-The University of Vermont, Burlington, VT, USA;[3] Sociologist and Development Projects Manager, Analysis Unit Coordinator-Fundación Neotrópica, San José, Costa Rica; [4] Natural Resources Manager, Technical Assistant-Fundación Neotrópica, San José, Costa Rica; [5] Expert in Tourism and Sustainability, Field Stations Director-Fundación Neotrópica, San José, Costa Rica; [6]Environmental Attorney and Environmental Politologist, Education Coordinator-Fundación Neotrópica, San José, Costa Rica; [7] Tropical Biologist, Director of the Center for Education and Community Empowerment Alvaro Wille-Trejos-Fundación Neotrópica, Osa, Costa Rica.

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I- Abstract

Costa Rica and Nicaragua both have extremely rich natural endowments and their own level of socio-ecological challenges to be able to conserve them adequately. The opening of a channel in the Portillos (Calero) Island region by the Nicaraguan government and the clearing of wetland forests in the same area (about 2.48 hectares of clear cutting plus other types of impacts in other areas) have created a conflict between these two neighbors under allegations of sovereignty and environmental damage. This conflict was brought to the jurisdiction of the International Court of Justice of The Hague. This paper summarizes some of the most important sources of data available that document the losses in terms of ecosystem services of the actions affecting the CNW in this conflict. These services are important not only to local populations but also to both nations and the world. To set an appropriate framework it summarizes some of the key literature that enhances the current importance of wetlands for one of the most pressing global socio-environmental problems: climate change. Further, it synthesizes the results in terms of ecosystem service potential and actual losses of RAMSAR´s Mission 69 report, UNOSAT report of January 2011 and on-site inspections carried on by personnel of Costa Rica´s National System of Conservation Areas (SINAC). It follows with a brief reflection of some of the remaining challenges that have not been resolved in order to resolve the problems that have originated the losses in ecosystem services of the CNW (valuation of the ecosystem services lost, role of the community stakeholders, the need for bi-national cooperation and international technical supervision). The conclusion summarizes the main findings including the extent of actual and potential ecosystem service losses and the estimated time of recovery for this RAMSAR wetland.

II- Introduction

In a time of crisis and environmental uncertainty, environmental conflicts abound. Costa Rica is a good example of this statement. The country has become very aware of the environmental conflicts that accompany two seemingly contradictory agendas. On one side, seeking to maintain a green republic (Evans, 1999) reputation as has been reaffirmed by international recognitions (such as the first place in the Happy Planet Index and the recognition of the Convention for Biodiversity of its Biodiversity Law, which came in 2010) and its tangible achievements: a reputable conservation area system with about 25% of its territory in protected areas and evidence of gains of forest cover during the last decade (FONAFIFO, 2007; UNEP, FAO, UNFF, 2009). At the same time, its government has been criticized for its apparent contradictory behavior in terms of fostering economic growth through measures for which it is not prepared to fully address the environmental impacts. This is the case of inadequate urban development, watershed management, tourism infrastructure and other development options deemed as depleting (Pera, 2008; Rogers, 2009; Honey, Vargas & Durham, 2010) .

The base of Costa Rica´s relatively enlightened behavior is its social base. A well educated population and relatively higher social indicators, resulting from its social democratic past, have been essential in promoting scientific and technical development (a good case study to support Pickett and Wilkinson, 2009). Recent development decisions have been accompanied by a concern on the widening gap between the wealthier and the poorest (Programa del Estado de la Nación, 2010; Aguilar-González, Chang & Leonard, 2010).

The result is a mixed bag of GDP and trade growth (GDP up to levels of 5 and 6% per year until 2009 when the GDP decreased by a 2.5% due mostly to the U.S. economic crisis) and ambiguous environmental and social indicators. For instance, 16% of the Costa Rican population still lives below the poverty line (in 1970 it was as high as 24%), the GINI Index of inequality in income is currently around 0.49 after having been in 1985 at its lowest level of .44. The ecological footprint of the country has increased from 1,95 global hectares per capita in 1999 to 2.77 today (lower ranking as 55th in the world down from 37 in 2001) and its biocapacity decreased from around 5.00 in 1960 to 2.50 in 2001 and to 1.81 global hectares per capita today.

This scenario has led to the development of ecological conflicts in areas where unsustainable models of development have been implemented. Yet, several areas of the country remain remote, protected and relatively pristine. This is the case of the Northeast region of Costa Rica, including several protected areas of great importance such as Tortuguero National Park, the Barra del Colorado Wildlife Refuge, the Border Wildlife Refuge and the RAMSAR Convention for Wetlands´ recognized Caribe Noreste Wetland (CNW) (made up by the first two) (Figure 1).

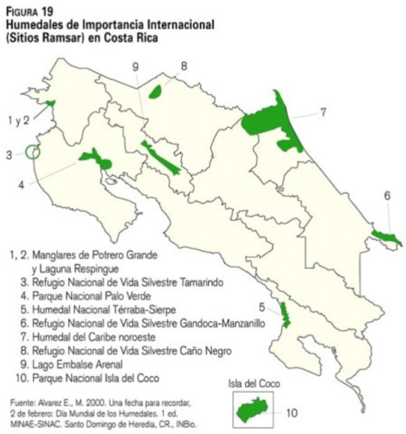

Figure 1- Location of the Caribe Noreste Wetland (7) as part of the RAMSAR Sites in Costa Rica. Source: MINAET, Costa Rica.

Nicaragua also has a challenging socio-ecological scenario. Its economy is heavily dependent in agriculture and other primary products. With a population that has more than doubled in the last 30 years, last year it saw a larger than expected growth in its GDP and Export Revenue, which is attributed to the increase in primary product prices. Its two main trade partners are the USA (28.7% mainly coffee and gold) and Venezuela (13.05% mainly coffee and meat) (ACAN-EFE, 2011; Sánchez, 2011). This growth was accompanied by the largest inflation in Central America (Marenco, 2011). Government advisors feel optimistic about the outlook for the economy this year due to new renewable energy projects and the increase in exports (América Economía, 2010). The country seeks to reverse the high poverty and migration situation that has characterized its reality in the last decades. A high poverty rate of 48% of the population is estimated. The migration ranking of Index Mundi places Nicaragua as number 123 of 178 countries in the world (Index mundi, 2011) indicating one of the highest migrating populations due to the conditions of the country.

In the environmental area, Nicaragua seeks to promote conservation through its young Ministry of the Environment and Natural Resources (MARENA) and civil society participation. It has some good indicators, for instance in its lower ecological footprint. Yet, Mongabay (2011) reports that Nicaragua lost 30 percent of its forest cover between 1990 and 2010, though its deforestation rate has fallen 17 percent since the close of the 1990s. The Foundation for Sustainable Development (2011) reports problems with agrochemicals in agricultural practices and water resources. Yet, both sites highlight the remaining wealth in forest resources that are located in the Caribbean coast of the country, a key component of the Mesoamerican Biological Corridor. South of these resources is another key wetland site of international recognition (RAMSAR) located in a relatively low populated area: the San Juan River

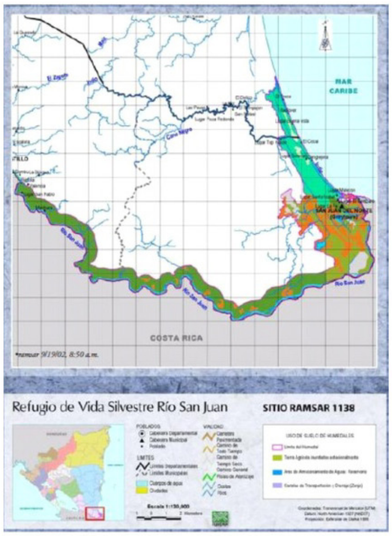

Figure 2- San Juan River Wildlife Refuge. Source: Comisión Centroamericana de Ambiente y Desarrrollo.

Wildlife Refuge (SJWR), opposite the Caribe Noreste Wetland on the Costa Rican side (Figure 2). Altogether, these two RAMSAR sites comprise over 118,000 hectares (75,310 for the CNW and 43,000 for the SJWR) of valuable wetlands.

The conservation of these bi-national resources has been challenged by the situation that has developed since October, 2010. Since then, the Costa Rican government denounced that Nicaraguan troops and construction personnel were executing work that went beyond the works that had been announced in a meeting between representatives of both governments (Arguedas y Oviedo, 2010).

The Costa Rican Ministry of Foreign Affairs has led the claim that the government of Nicaragua has unlawfully constructed a channel by deforesting its territory and is executing a dredging program that will impact its territory. Further, Nicaraguan troops were stationed in the northern section of Portillos Island, north of Calero Island. The Nicaraguan government claims that it was executing works in what is its territory according to its interpretation of the border treaties. This interpretation was initially substantiated in a map from Google maps (which generated controversy) and in its reading of the results of the Alexander arbitration (http://google-latlong.blogspot.com/2010/11/regarding-boundary-between-costa-rica.html) according to which there used to exist a natural channel out of Portillos Lagoon, or Harbor Head Lagoon as the Nicaraguans denominate it, that connected it with the San Juan River (Figure 3).

Figure 3- Google Image indicating the border between Nicaragua and Costa Rica in yellow. The caption at the critical ogle web site reads: *"Current incorrect border in Google Earth, showing the S-shaped river course"*. Source: http://ogleearth.com/2010/11/about-costa-rica-nicaragua-their-border-and-google/

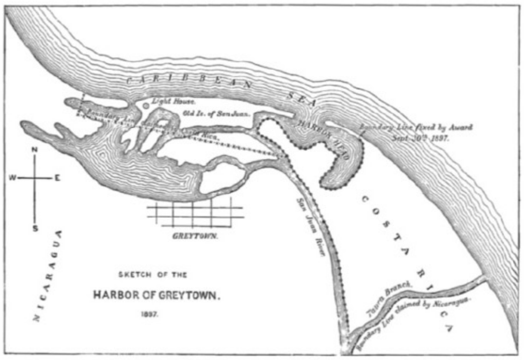

Figure 4- 1897 Map contained in the first arbitral award given by Alexander indicating both the Nicaraguan and Costa Rican claim on where the border line should be located and the Boundary Line Fixed in 1897. Source: Moore, 2007.

Costa Rica claims that this channel never existed, that there is no historical evidence of it in the cartography of the 19th century and, in particular, in the maps of the Alexander arbitration, and that General Alexander refers in his border description to the channel running parallel to the Caribbean coast that connected the San Juan River with Portillos Lagoon, north of the disputed area (Figures 4 and 5). Therefore, Costa Rica claims the work as unlawful and the presence of Nicaraguan army soldiers as an armed invasion of its territory (República de Costa Rica, 2010).

Costa Rica took its claim to the Organization for American States which resolved to support the Costa Rican arguments and recommended that the Nicaraguan army should vacate the area. Nicaragua disregarded the decision alleging that OAS did not have jurisdiction to intervene in the conflict.

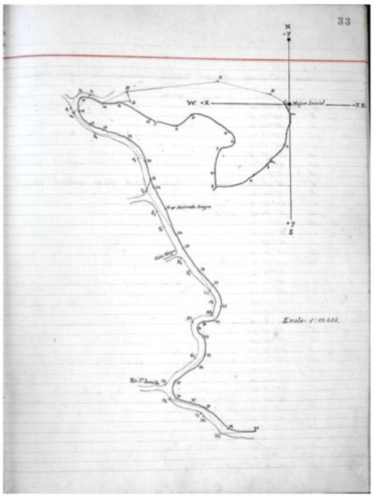

Figure 5-Sketch from the Alexander Arbitration files presented as evidence by Costa Rica. Source: Hale, 2010.

In view of the scale of the works that continued, the Costa Rican government focused on the environmental damage that is being caused as an additional argument point to strengthen its claim consonant with its environmental reputation. The serious perceived impacts have been documented and commented on in an ample way by Costa Rican scientists and environmental NGOs (República de Costa Rica, 2010). The government invited RAMSAR Convention on Wetlands´ technical missions to inspect the site and contracted the UNOSAT service from the United Nations to technically verify the environmental damages being caused by the works. The first visit of the RAMSAR technical mission took place between November 27^{th} and December $1^{st.}$, 2010. The report was sent to Costa Rica shortly thereafter. Both these reports were used to substantiate a claim filed on November 11^{th}, 2010 by the Costa Rican government against the Nicaraguan government in the International Court of Justice (ICJ) in The Hague, The Netherlands.

The claim seeks that the Court declares that Nicaragua is in breach of its international obligations as regards the incursion into and occupation of Costa Rican territory, the serious damage inflicted to its protected rainforests and wetlands, and the damage intended to the Colorado River, wetlands and protected ecosystems, as well as the dredging and channelization activities being carried out by Nicaragua on the San Juan River (ICJ, 2011).

As a preventive petition, Costa Rica asked the ICJ to approve the following provisional measures, given the irreversible nature of the damages alleged:

1- Nicaragua shall not, in the area comprising the entirety of Isla Portillos, that is to say, across the right bank of the San Juan River and between the banks of the Laguna Los Portillos (also known as Harbor Head Lagoon) and the Taura River ('the relevant area'):

a- station any of its troops or other personnel;
b- engage in the construction or enlargement of a canal;
c- fell trees or remove vegetation or soil;
d- dump sediment;

2- Nicaragua shall suspend its ongoing dredging program in the San Juan River adjacent to the relevant area and,
3- Refrain from any other action which might prejudice the rights of Costa Rica, or which may aggravate or extend the dispute before the Court.

Nicaragua´s government rejected both the claim and the petition for provisional measures sticking to its main argument that it is acting based on sovereign rights. Further, it has rejected the environmental basis of the claim based on three main considerations: 1- the fact that it has sufficient environmental impact analyses according to law; 2- the fact that its works are just clearing a preexisting channel, aside from the dredging of the San Juan River, and 3- the support of its scientific and environmental NGO community (Grupo Ad-Hoc de Observación Ambiental, 2011).

Costa Rica rebutted these arguments as false or insufficient. As can be seen from this summary of facts, this is a socio-ecological conflict of international dimensions, with very important environmental resources at stake, which has become extremely polarized. It is clear that the most credible sources for technical information will be those coming from international technical institutions. The only two sources of this nature at the time are the RAMSAR report of the technical mission 69 invited by Costa Rica and the UNITAR/UNOSAT report "Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica" from January, 2011. Nicaragua rejected the RAMSAR report, calling it partial and lacking on the ground verification (Grupo Ad-Hoc de Observación Ambiental, 2011; Asamblea Nacional de la República de Nicaragua, 2011). Yet, until now, the convention authorities support its conclusions. Nicaragua invited a technical mission to make an assessment directly in the area of the San Juan River. The mission visited Nicaragua between March 7 and 13, 2011. Further, Costa Rica invited a second RAMSAR Mission. The second Costa Rican report is still not in the public domain as we finish this paper. The Nicaraguan report seems to have been rejected by the Nicaraguan government.

It is clear that there is no transboundary environmental impact statement to evaluate an impact that is clearly transboundary. The significance of the impact (actual and potential) could be lost in finger pointing about sovereignty.

The ICJ resolved the petition for provisional measures on March 8, 2011, supporting some of the arguments expressed above. It ordered an exclusion zone in the area north-northwest of the canal that Costa Rica claims never existed (accepting petitions 1 a,b and c from Costa Rica yet including the prohibition of permanent personnel for both countries) which it calls "disputed territory" and granted Costa Rica´s provisional measure number 3. Recognizing the importance of RAMSAR it ordered an additional provisional measure whereby, given the fact that it considered plausible that the Direct Impact Area has belonged to Costa Rica for over 100 years, it gave Costa Rica possibility to "dispatch civilian personnel charged with the protection of the environment to the disputed territory, including the *caño* (channel), but only in so far as it is necessary to avoid irreparable prejudice being caused to the part of the wetland where that territory is situated; Costa Rica shall consult with the Secretariat of the RAMSAR Convention in regard to these actions, give Nicaragua prior notice…" (ICJ, 2011). With a tense environment of mutual accusations, the conflict continues today as the parties prepare to present their claims and evidence to the court.

This paper follows the commitment that Fundación Neotrópica embraced 2 years ago for the protection of Costa Rican wetlands with two action community based projects. The first one, ECOTICOS, a collaborative project, funded by the Blue Moon Fund from the U.S., between the University of Vermont´s Gund Institute for Ecological Economics, Neotrópica and several Costa Rican and US counterparts which yielded not only very participatory results but also tangible policy outcomes for the conservation of the endangered Terraba-Sierpe Wetland Reserve (Aguilar-González and Moulaert-Quirós, (in review (a)). The second one, Mangle-Benin, a collaborative south-south cooperation community mangrove conservation project, funded by the government of The Netherlands and focused on the mangrove areas of the Gbaga Channel in Benin and the Dulce Gulf in the Osa peninsula, Costa Rica (González and Herrera, 2010).

In view of the urgency to understand the full extent of the damage inflicted to the ecosystems at stake, it seeks to synthesize some of the most important sources of data available that document the losses in terms of ecosystem services of the actions affecting the CNW in this conflict. These services are important not only to local populations but also to both nations and the world.

To set an appropriate framework it summarizes some of the key literature that enhances the current importance of wetlands for one of the most pressing global socio-environmental problems: climate change. Further, it synthesizes the results in terms of ecosystem service potential and actual losses of RAMSAR´s Mission 69 report, UNOSAT report of January 2011 and on-site inspections carried on by personnel of Costa Rica´s National System of Conservation Areas (SINAC). It follows with a brief reflection of some of the remaining challenges that have not been resolved in order to resolve the problems that have originated the losses in ecosystem services of the CNW (valuation of the ecosystem services lost, role of the community stakeholders, the need for binational cooperation and international technical supervision).

Finally, it seeks to stimulate a reflection that leads to a path to manage uncertainty focusing on information quality. It also hopes to stimulate pertinent actions and to open a participatory process that captures the interests that should be involved in the solution to the causes of the conflict.

III- The Importance of Wetland Environmental Services for Climate Change Today

Wetlands constitute today one of the most important ecosystems from the perspective of global environmental problems. Therefore, the attention that they are receiving in this conflict and the final results of the trial in The Hague are of great importance not only for the countries involved but for the world as a whole.

According to Thomas, et. al. (in review) the absence of Blue carbon from the climate policy discourse up until today has been an important deficiency, as the ocean is a dominant component of the global carbon cycle and more than half of all carbon accumulated in vegetation through photosynthesis is in marine organisms. Vegetated coastal ecosystems including mangrove forests, salt marshes and seagrass meadows are immensely important ecological resources and have been largely unregarded. These areas provide vital ecosystems services including the provision of habitat, production of food, regulation of local climate and disease vectors, nutrient cycling and pollination, stabilization and protection of coastal areas and are highly effective carbon sinks. Blue carbon projects (as the international community denominates the projects that emphasize the role of these ecosystems in addressing climate change) not only generate these ancillary benefits but develop the adaptive capacity of coastal communities that are likely to be disproportionately affected by the biophysical impacts of climate change (Acevedo and Sacre, 2010).

Thus, the international scientific community is today paying strong attention to the conservation of these ecosystems. For instance, on World Environment Day 2009, UNEP made a strong case for biosequestration — carbon stored in ecosystems such as plant biomass, soils, wetlands and pasture — in its rapid assessment report The Natural Fix? The Role of Ecosystems in Climate Mitigation produced by UNEP–World Conservation Monitoring Centre (Trumper, et. al., 2009).

Instead of relying on costly technologies such as carbon capture and storage, boosting investments in the conservation, rehabilitation and management of the Earth's forests, peatlands, soils and other key ecosystems can deliver significant cuts in carbon emissions and avoid even more being released to the atmosphere. Such activities have the added benefit of preserving the huge range of services and goods these ecosystems provide to local people and the wider community, the report concluded

The report highlights the role of coastal wetlands which have the potential to accumulate carbon at high rates over long time periods because they continuously accrete and bury organic-rich sediments. However there is widespread agreement that if current patterns of use, exploitation and impacts persist, coastal wetlands will become carbon sources rather than sinks estimate that widespread loss of vegetated coastal habitats has reduced carbon burial in the ocean by about 0.03 Gt C per year.

A key study in comparative analysis is Laffoley and Grimsditch (2009) Coastal marine habitats such as mangroves, seagrass meadows, kelp forests and tidal salt marshes each account for areas 1% or less of the dominant terrestrial habitats of forests, grasslands and deserts. The carbon stock in these marine systems, however, is similar to that observed in many of these terrestrial systems (Table 1).

Table 1- Comparison of carbon stocks and longterm accumulation of carbon in soils in key terrestrial and coastal marine. Source: Laffoley and Grimsditch (2009)

Ecosystem type	Standing carbon (gCm^2)		Total Global Area ($*10^{12}$ m^2)	Global carbon stock ($*10^{15}gC$)		Long-term rate of carbon accumulation in sediment ($gC\ m^{-2}y^{-1}$)
	Plants	Soil		Plants	Soil	
Tropical Forests	12,045	12,273	17.6	212	216	2.3-2.5
Temperate Forests	5,673	9,615	10.4	59	100	1.4-12.0
Boreal Forests	6,423	34,380	13.7	88	471	0.8-2.2
Tropical Savannas and Grasslands	2,933	11,733	22.5	66	264	-
Temperate Grasslands and Shrublands	720	23,600	12.5	9	295	2.2
Deserts and Semi-deserts	176	4,198	45.5	8	191	0.8
Tundra	632	12,737	9.5	6	121	0.2-0.7
Croplands	188	8,000	16	3	128	-
Wetlands	4,286	72,857	3.5	15	225	20
Tidal Salt Marshes	-	-	Unknown (0.22 reported)	-	-	210
Mangroves	7,990	-	0.152	1.2	-	132
Seagrass Meadows	184	7,000	0.3	0.06	2.1	83
Kelp Forests	120-720	na	0.02-0.4	0.009-0.02	na	na

As this data shows, wetlands are one of the most carbon capturing ecosystems globally. Degrading or removing these habitats therefore has comparable immediate carbon emissions as degrading or removing similar sized areas of terrestrial habitat (Laffoley and Grimsditch, 2009). All these figures appear highlighted in yellow in Table 1.

The dramatic difference between the coastal marine and terrestrial habitats is the capacity of marine habitats for long term carbon sequestration in sediments. Carbon burial in coastal ocean sediments by mangroves, seagrasses and other vegetation has been largely ignored in most accounts of the global carbon cycle –likely a result of the small areal extent of these habitats and a reflection of the fact that only human-induced sequestration (ie afforestation and reforestation) is accounted for in national greenhouse gas inventories (Laffoley and Grimsditch,2009).

However, vegetated coastal habitats transfer large amounts of carbon to the sediments, contributing about half of the total carbon sequestration in ocean sediments even though they account for less than 2% of the ocean surface. Moreover, these high burial rates can be sustained over millennia. The large carbon sequestration capacity of coastal habitats arises in part from the extensive belowground biomass of the dominant vegetation (Laffoley and Grimsditch, 2009).

Strengthening these arguments, Nellemann, et. al. (2009) report on Blue Carbon published by UNEP, state that maintaining or improving the ability of forests and oceans to absorb and bury CO_2 is a crucial aspect of climate change mitigation. The ocean's vegetated habitats, in particular mangroves, salt marshes and seagrasses, cover <0.5% of the sea bed. These form earth's blue carbon sinks and account for more than 50%, perhaps as much as 71%, of all carbon storage in ocean sediments. They comprise only 0.05% of the plant biomass on land, but store a comparable amount of carbon per year, and thus rank among the most intense carbon sinks on the planet. Blue carbon sinks and estuaries capture and store between 235–450 Teragrams of carbon (Tg C) every year – or the equivalent of up to half of the emissions from the entire global transport sector, estimated at around 1,000 Tg C yr–1. By preventing the further loss and degradation of these ecosystems and catalyzing their recovery, we can contribute to offsetting 3–7% of current fossil fuel emissions (totaling 7,200 Tg C yr–1) in two decades – over half of that projected for reducing rainforest deforestation. The effect would be equivalent to at least 10% of the reductions needed to keep concentrations of CO_2 in the atmosphere below 450 parts per million (ppm). Therefore, if managed properly, blue carbon sinks, therefore, have the potential to play an important role in mitigating climate change.

This report also comments on the rate of loss of these marine ecosystems which is much higher than any other ecosystem on the planet – in some instances up to four times that of rainforests. Currently, on average, between 2–7% of our blue carbon sinks are lost annually, a seven-fold increase compared to only half a century ago. If more action is not taken to sustain these vital ecosystems, most may be lost within two decades. Halting degradation and restoring both the lost marine carbon sinks in the oceans and slowing deforestation of the tropical forests on land could result in mitigating emissions by up to 25%.

It concurs that sustaining blue carbon sinks will be crucial for ecosystem-based adaptation strategies that reduce vulnerability of human coastal communities to climate change. Halting the decline of ocean and coastal ecosystems would also generate economic revenue, food security and improve livelihoods in the coastal zone. It would also provide major economic and development opportunities for coastal communities around the world, including extremely vulnerable Small Island Developing States (SIDS).

The more recent World Bank report by Crooks, et. al. (2011) reinforces the notion that coastal wetlands and marine ecosystems sequester carbon within standing biomass, but even more within soils. In many cases these peat-like soils have been continuously building for over 5,000 years, or longer. Wetlands in saline environments have the added advantage of emitting negligible quantities of methane, a powerful greenhouse gas, whereas methane production in freshwater systems partially or wholly negates short-term carbon sequestration benefits. However, over multi-century time scales all coastal wetlands are net Greenhouse Gas (GHG) sinks.

This research is more specific on the details of this ecosystem´s degradation. It states that human-caused drainage of coastal wetlands releases carbon from soils, turning them into a strong net source of GHG emissions, irrespective of their GHG balance in the natural state. Soils vary in carbon content across the landscape but a "typical" coastal wetland soil releases 0.1 Metric tons of Carbon Dioxide ($MtCO_2$) per square kilometer for every depth meter of soil lost, though with a wide range. Averaged over a 50-year period this equates to 2,000 tCO_2 km-2 yr-1, though rates of loss are particularly high in the first decade of wetland drainage. Coastal wetlands are being rapidly converted to agriculture and other land-uses around the world, leading to significant emissions. Between 1980 and 2005, 35,000 km^2 of mangroves were cleared and drained. Crooks et. al (2011) estimates that this area of wetland alone will continue to release 0.07 $GtCO_2$ every year. Loss of the remaining 152,308 km^2 of mangroves would release 0.3 $GtCO_2$ over the same time; as well as result in incalculable losses in other ecosystem processes and services. Remaining coastal wetlands with peat-rich soils, which release higher than average amounts of carbon per unit area, are being rapidly converted for oil palm plantations and aquaculture in parts of Southeast Asia and Latin America.

This recent literature agrees on the need to immediately and urgently protect at least 80% of remaining seagrass meadows, salt marshes and mangrove forests, through effective management. It also emphasizes the need to initiate management practices that reduce and remove threats, and which support the robust recovery potential inherent in blue carbon sink communities.

IV- Costa Rican Policies and Challenges in Wetland Conservation

Costa Rica´s historical commitment with wetland conservation can be summarized starting with the use of a brief legal case study by Aguilar (1998). According to it wetlands in Costa Rica occupy 4% of the national territory. It estimates that of these 208,000 hectares, 30,000 hectares are mangroves, including 1,460 km of coastline.

This research states that Costa Rican legislation started focusing on wetlands since its Water Law of 1942. This pioneer effort was followed in 1977 by the Law of the Maritime Zone which categorizes mangrove forests as Forest Reserves. The term wetland is first introduced in the Law of Wildlife Conservation of 1995 which is a follow up to Costa Rica´s ratification of the RAMSAR convention in 1991 (Aguilar, 1998).

Further, since the mid nineties a National Strategy for the Conservation of Wetlands and the Organic Law of the Environment enhanced the regulations covering this object of conservation. This last law categorized all wetlands as protected areas per legal mandate (Aguilar, 1998).

Several attempts of reform and legal challenges have focused on this concept. It has been upheld by the constitutional court. Nevertheless, there seems to be confusion as to the administrative jurisdictions because of duplicity or lack of clarity. In this effort, Aguilar (1998) recognizes that Costa Rica has done a strong effort that may have led to confusion among regulators and between users. Among the reasons for this is the fact that the legal mandate to consider them a protected area category does not have a definition of management guidelines as other models have: national parks, biological reserves. Therefore it is very common today that the wetlands that are better protected are those that exist within the boundaries of other models of protected areas (as National Parks, Biological Reserves of National Wildlife Refuges).

This situation has led to some areas of wetlands being less effectively protected or subject to more pressures given the potential development projects to be executed in the area. The level of public accountability for conservation authorities In charge of wetlands has noticeably risen since the conflict for the damage caused to the CNW started. A group of very active non-governmental organizations, university scholars, students and others have held Costa Rican authorities accountable for maintaining coherence between the environmental position presented to the Hague and the actual protection of all wetlands in the country.

This has resulted in heated discussion and the uncovering of the limitations that the country needs to overcome today in wetland conservation (Neotropica.org/el pais.cr, 2011). Among them, the Vice minister of the Environment, Ana Lorena Guevara has stated that Costa Rica has a strong commitment to its wetlands but that human resources are not sufficient. The country has today about 941 wetlands covering about 7% of the national territory. Only 350 have an additional protected area management category and, due to their importance, at least 11 are RAMSAR sites. She has declared that the government is committed to solving the weaknesses it has in this area (Guevara, 2011).

The fiscal situation of Costa Rica is tight today. A similar voice of concern has been expressed by the Administrative Environmental Tribunal while revealing the results of its inspections in the Térraba-Sierpe Wetland. The Tribunal complains of lack of resources and shortened budgets (Blanco, 2011). In this situation, the support of NGOs and civil society is proving key in supporting these efforts.

Fundación Neotrópica is collaborating with the tribunal with data from its wetland conservation projects. These efforts have received attention from international cooperation. Currently Fundación Neotrópica executes, in partnership with organizations from Germany, Switzerland, the Netherlands, Austria and Brazil, a project called CiVi.net. This project sees to document and analyze the possibilities of transferring successful experiences in community wetland conservation. One of the case studies selected focuses on the efforts generated through the projects ECOTICOS (funded by the Blue Moon Fund) and MANGLE-BENIN (funded by the government of the Netherlands) which demonstrate the effectiveness of community conservation in complementation of government work in order to protect Costa Rican wetlands. The funding for this project comes from the FP7 program of the European Union and implies a recognition to these collaborative efforts of wetland conservation which result in tangible gains that can help overcome public resource limitations (Aguilar-González and Moulaert-Quirós, in review(a)). The interest of the project is to replicate this model in other areas of the country. Other NGOs focus their efforts on other wetlands around the country and since December 2010 a National Front by the Protection of Wetlands was constituted by several civil society, academic, student activism and private sector organizations.

V- The RAMSAR Technical Mission 69 Assessment of the Effects of the October 2010 Actions on the Caribe Noreste Wetland and the UNOSAT Mission

The concern of Costa Rica for the conservation of its wetlands was expressed in the conflict for the works executed in Isla Portillos/Calero in its use of technical expertise to prove the damage caused. This commitment to credible technical information has been maintained regardless of fiscal limitations due to the economic conditions of the country. Both technical documents resulting from these processes define the extent of environmental damage considered in this paper. Costa Rica reported the changes to the CNW on November 15 and 22, 2010 and requested based on article 3.2 of the RAMSAR treaty a mission to evaluate the damage. The mission came to Costa Rica between November 27 and December 1 and its main goal to evaluate the ecological changes in the CNW and to issue recommendations to maintain the ecological characteristics of this site from a technical perspective without getting the Secretariat involved in any political situation between the parties (RAMSAR Advising Mission 69, 2010).

The report issued on December 17 emphasizes that the purpose of the mission and report is not to make any judgment on the political or juridical aspects of the actions being done in the CNW but to evaluate the situation in a technical and impartial way and to arrive at, based on this evaluation, a series of conclusions and recommendations to government instances and decision makers (RAMSAR Advising Mission 69, 2010).

From the visit to Costa Rica, consultations and technical information reviewed, the Mission concluded and recommended:

1- From the technical information provided by the government of Costa Rica there were changes in the ecological conditions of the CNW in the area of direct influence defined as close to 225 ha (2.25 km^2) or 0.3% of the total area of the wetland;

2- The aquatic system in its components of quality of water, flora and fauna and the resident and migratory birds would be the most affected;

3- Even if the analysis was focused on the CNW it became clear, from the information analyzed, that Portillos Lagoon, located in the RAMSAR site San Juan Wildlife Refuge (SJWR), would be the most affected by the hydraulic connection with the San Juan River;

4- Assuming the dredging of the San Juan River continued, the sediments could not be deposited in the CNW;

5- If the magnitude and size of the alterations on the San Juan River continued (relative to its state before them) it would be probable that the medium and long terms scenarios forecasted in the report would become real (RAMSAR Advising Mission 69, 2010).

The report adheres to the recognition of the Millennium Ecosystem Evaluation´s definition of Ecosystem Services in wetlands presented in Table 2.

Table 2 - Ecosystem services in wetlands as defined the by Millennium Ecosystem Evaluation from 2005. Source: Adapted from RAMSAR Advising Mission 69 (2010).

Supply of Services	Regulation of Services	Cultural Services
Products obtained from the ecosystems • Food • Potable water • Fuel • Vegetable fiber • Biochemicals • Genetic resources	Benefits obtained from ecosystem regulation processes • Climate regulation • Disease control • Water regulation • Water purification • Pollination	Non material benefits received from ecosystems • Spiritual and religious • Recreational and touristic • Aesthetic • Inspirational • Educational • Sense of identity • Cultural capital
Support Services Services necessary for the production of all the other services of the ecosystem Soil formation Nutrient Cycling Primary Productivity		

The report recognizes that from these services flood control, recharge of the water table, sediment and nutrient retention, water purification, biodiversity and wetland products such as sport and subsistence fisheries, hunting and forest products and recreation for tourism can be highlighted as being at stake at the CNW.

It highlights that it is one of the areas of highest terrestrial biodiversity in the Costa Rican Caribbean in habitats such as:

- Beach vegetation,
- High forests in hills,
- Flooded forests,

- Rafia or Yolillo *(Raphia taedigera)* areas,
- Herbaceous swamps,
- Floating herbaceous communities.

It contains one third of the endangered species of fauna that are declared as endangered in Costa Rica (RAMSAR Advising Mission 69, 2010).

The changes documented in the report have occurred in the area denominated as Direct Influence Area (DIA) which is located in Isla Portillos bordering the San Juan river in the west, the Caribbean sea in the north-northeast and the south-southwest shoreline of Portillos Lagoon or Harbour Head up to the site named Aragón (225 ha of wetlands in Isla Portillos).

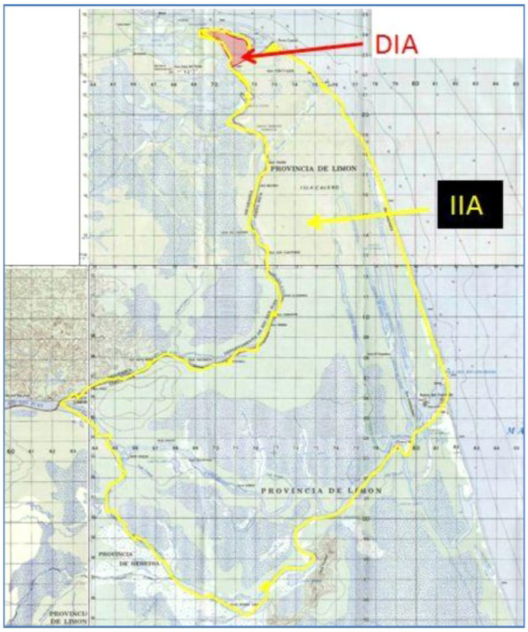

Figure 6- Approximate location of the DIA and IIA according to the description of the RAMSAR Report. The line of the diagram on the San Juan River should be interpreted strictly on the Costa Rican Edge. Source: Authors Based on Official CR-IGN Maps 1:50:000

The report also recognizes an Indirect Influence Area (IIA) to be the coastal area from the mouth of the San Juan River to the mouth of the Colorado River as well as the delta of the San Juan River and the rest of the wetlands located in Isla Portillos (According to this description about 21,500 ha.). It also recognizes that adjacent to the IIA is Portillos Lagoon which is part of the RAMSAR SJWR (RAMSAR Advising Mission 69, 2010) (Figure 6).The report says that according to the evidence shown by Costa Rica the following events are indicated as causing the changes:

- Dredging of the San Juan River west of Portillos lagoon,
- Sediment deposition in the CNW coming from the San Juan River in the area of Portillos Island. The estimated sediment deposit at that time (November, 2010) was 1688 m^3 (0,24 ha),
- Cutting of the vegetation of the CNW (forest and understory vegetation), the forest cover was at that time 5.75 ha (1.67 ha of trees and 4.8 ha of understory vegetation),

- Flooding of soils by the construction of an artificial channel (RAMSAR Advising Mission 69, 2010).

The report evaluates changes in physical aspects of the area (changes in the local recharge of the wetland aquifer, in the hydrological network, in the superficial hydrology, soils and subterranean geomorphology and hydrology.

It also evaluates changes in ecosystem components. In terms of water it evaluates the changes in the quality of the water by the increase in the flow of fresh water into the estuarine system of Portillos lagoon, the trophic state of Portillos lagoon due to a decrease in the time of residence of nutrients and organic material, in the quality of water due to the increase of fresh water flows on the insular wetland of Portillos island, in the quality of the superficial aquifer of the insular wetland due to the entrance of waters from the San Juan River and in the trophic state of the insular wetland. It evaluates changes in flora and vegetation in terms of the changes in vegetation cover due to the clear cutting in the insular wetland, the abundance and distribution of aquatic species in Portillos lagoon and the insular wetland, of the abundance and distribution of terrestrial species in the insular wetland and in the rate of growth of vegetation species in the insular wetland. In terms of fauna it evaluates changes in the abundance and distribution of aquatic species (especially fish in Portillos lagoon and the insular wetland), loss of aquatic habitat by the transformation of a still to a flowing water condition, changes in the trophic chain and reproductive success of aquatic species in Portillos lagoon and the insular wetland, loss of habitat for migrant and resident birds in the insular wetland and Portillos lagoon, changes in the distribution and abundance of terrestrial species and fragmentation of biological corridors in the insular wetland (RAMSAR Advising Mission 69, 2010).

Based on the evaluation of these changes from the information provided, the RAMSAR mission constructed short (3 to 6 month), medium (1 year) and long term (5 to 10 years) scenarios for the DIA and the IIA. The scenarios for the DIA consider only the creation of the hydraulic connection between the San Juan River and the Portillos lagoon, without considering modifications in the superficial flows. The scenarios for the IIA additionally considered the main flow of the San Juan River being directed to the artificial channel rather than to the current mouth (Table 3).

The other important piece of technical evidence presented in the proceedings coming from an international technical source is the UNITAR/UNOSAT report "Morphological and Environmental Change Assessment: San Juan River Area (including Isla Portillos and Calero), Costa Rica" (2011). UNOSAT is a program of the United Nations Institute for Training and Research (UNITAR), providing satellite imagery and related geographic information, research and analysis to UN humanitarian & development agencies & their implementing partners (UNOSAT, 2011). The report presented a review of a 30 year time series of satellite imagery dating from 1979 for significant morphological and environmental changes in Costa Rica along the San Juan River area focusing on the areas of Portillos Island and Calero Island. It stated that 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 Los Portillos Lagoon (UNOSAT, 2011).

Table 3– Short, Medium and Long Terms Scenarios Based on the Ecological Changes Evaluated by the RAMSAR Mission 69 Report. Source: Adapted from RAMSAR Advising Mission 69 (2010)

	Short Term Scenario (3 to 6 month)	Medium Term Scenario (1 year)	Long Term Scenario (5 to 10 years)
Direct Influence Area (225 ha)	• Changes in rates of biogeochemical processes • Alteration in the flow of environmental services and products	• Changes in behavior and morphology of Portillos Lagoon • In one hydrological cycle the total or partial loss of Portillos Lagoon due to the breaking of the bar between the lagoon and the Caribbean Sea • In the insular wetland the extension of the flooded zone will increase showing fluctuations correlated to the dynamics of the San Juan River • Water stress will increase over tree and understory vegetation due to flooding generating a halo of dead vegetation • Loss of habitat for terrestrial fauna	• Erosive processes will be activated on the wetland due to the transformation of Portillos Lagoon into a flowing water system • The recharge of the aquifer will be altered under the insular wetland • Due to the flow of the artificial channel the full extent of the wetland could be eroded • The wetland will be completely modified due to the hydraulic connection between the San Juan River and Portillos Lagoon, the change of the recharge of the water table under the insular wetland, the flow of sediments, the quality of water in the Portillos Lagoon which will change in morphology from a lagoon to a bay with more salt water
Indirect Influence Area (approx. 21,500 ha)	• No changes expected since the flow patterns of the San Juan River delta will not be altered by the hydraulic connection between the river and Portillos Lagoon. The systems will have their normal variability	• Due to the loss of the bar between Portillos Lagoon and the Caribbean Sea there will be changes in the biogeochemical processes, alteration of the habitats and of the flows of ecosystem services and products. • Diminished flow, increase of sedimentation rate and on the trophic state of the water. • Increase in the erosion of the rest of the wetlands present in Portillos Island (southeast side of the artificial channel)	• Habitat modification from a static to a flowing system dynamic due to the main discharge occurring through the artificial channel. • Portillos lagoon will become functionally similar to the current mouth of the San Juan River and the current mouth will become like Portillos lagoon currently.

The report was divided in two analysis sections. The first one is a review of the assessment area and the second one is an analysis of the changes between the San Juan River and the Los Portillos Lagoon. The first section concluded that the area had been environmentally stable over the past 30 years, with small indications of morphological change. The second section concluded that there were indications of recent vegetation removal in the immediate area. New growth could be seen and was visibly thinner than surrounding sections. It identified “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 was 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." (UNOSAT, 2011).

This report verifies most of the actions that have caused the ecological changes evaluated by the RAMSAR report, illustrating the dynamics through time between August and December 2010. A summary of its conclusions is presented in Figure 7.

From the conclusions of the two mentioned reports we can summarize that:

1- The actions taken in the DIA by the Nicaraguan government have altered the ecological conditions of the Costa Rican HCN, part of the network of trans-boundary RAMSAR sites;

2- These actions have actual and potential consequences on the provision of environmental goods and services both of the DIA and the IIA. The consequences in this provision are verifiable, according to the RAMSAR evaluation and the UNOSAT report in the short run in the DIA. They would be verifiable, given the conditions specified in the report, in both the medium and long terms in both regions;

3- The reports were assertive on the fact that the effects can happen yet lack sufficient clarity as to define the extent to which the flows affected will be reduced.

4- The DIA measures 225 ha mostly composed by wetland and flooded forest type vegetation. The IIA measures about 21,500 ha, yet the reports are not clear in terms of the land cover in this area. Additional information obtained from CENAT-Prias and FUNDECOR´s maps of the Tortuguero Conservation Area based on multispectral MASTER 2005 images as well as JAPDEVA maps allow conservative estimates of approximately 14,450 hectares of forest, 5,900 hectares of grassy and palm wetlands and around 1,150 hectares of rivers, lakes and natural channels.

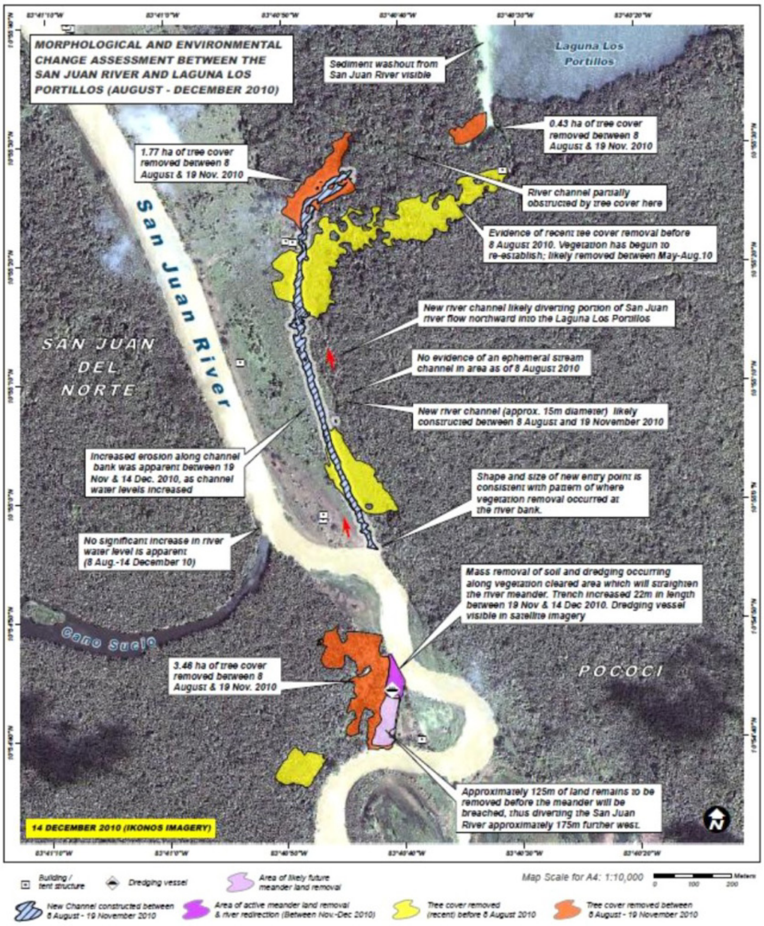

Figure 7- Map 2 from UNOSAT report summarizing the identified changes in the ecosystem between August 2010-December 2010. Source: UNOSAT, 2011.

V- Specific Environmental Service Losses as Derived From the Inspections by ACTO Officers from October 2010 and April 2011

Through the use of more specific data on the damages caused in the area of 5.75 hectares that according to the RAMSAR mission 69 report was directly altered in order to open a canal between the San Juan river and Los Portillos Lagoon, we are able to make a partial estimate of the actual losses caused by the actions of tree and vegetation removal.

Two inspections were executed by the Tortuguero Conservation Area (ACTO) in the DIA in the area of the canal on October 25th, 2010 and April 5th, 2011 while accompanying a second RAMSAR technical mission requested by the Costa Rican government. Technical reports were written for both inspections (Araya, 2011a, 2011b).

According to the report "Approximate age of the trees cut in the Area Under Environmental Administration by Costa Rica located on the line of an artificial canal built in a portion of Calero Island to connect the San Juan river with Portillos Lagoon" by Miguel Araya (2011a), a series of trends are summarized in Table 4.

Table 4- Summary Statistics for the Trees Removed by October, 2010 According to Araya (2011a) Including Biomass and Carbon Stored. Source: Authors based on Araya (2011a).

Species	Common Name	Number of Trees	Total Volume (m^3)	Total Biomass (Kg.)	Average Age	Carbon in biomass (Kg.)
Caesarea spp.	Cesarea	1	0.06	38.89	30	17.11
Ceiba pentandra	Ceiba	2	6.34	8,631.38	129	3,797.81
Grias cauliflora	Tabacón	2	1.50	1,881.29	50	827.77
Inga spp.	Guabilla	3	0.67	750.15	36	330.06
Lonchocarpus spp.	Chaperno	1	0.18	184.03	30	80.97
Mimosaceae		6	0.63	598.14	33	263.18
Pachira aquatic	Popenjoche	19	12.28	16,100.08	57	7,084.04
Pentaclethra macroloba	Gavilán	3	4.01	5,419.62	83	2,384.63
Pterocarpus officinalis	Sangrillo	136	325.54	422,767.08	144	186,017.52
Simira maxonii	Guaitil Colorado	3	0.87	1,071.65	43	471.53
Spondias mombin	Jobo	2	1.64	2,287.69	69	1,006.58
Symphonia globulifera	Cerillo	7	3.74	5,079.20	55	2,234.85
Unidentified		12	6.18	8,105.974	41	3,566.63
Total		197	363.64	472,915.17	115	208,082.67

The table includes estimates on total biomass per species and carbon stored in this biomass. These calculations were done according to the methodologies presented in Obando-Vargas, et al (2009) and Mena (2008) for humid tropical forests. The total carbon stored in the biomass would amount to an equivalent in greenhouse gases of 762,969.80 kg of carbon dioxide. These emissions are the equivalent in this greenhouse gas to the typical emissions of 139 passenger cars in one year according to estimates of the United States Environmental Agency for 2005 (EPA, 2005).

Araya (2011b) makes a much more comprehensive evaluation and description of the directly impacted areas. Figure 8 (adapted by ACTO from his original for a report submitted to the Ramsar Secretariat) shows the main areas impacted at Portillos Island between October and December 2010, including the artificial canal, three zones where primary forest was cut down, and

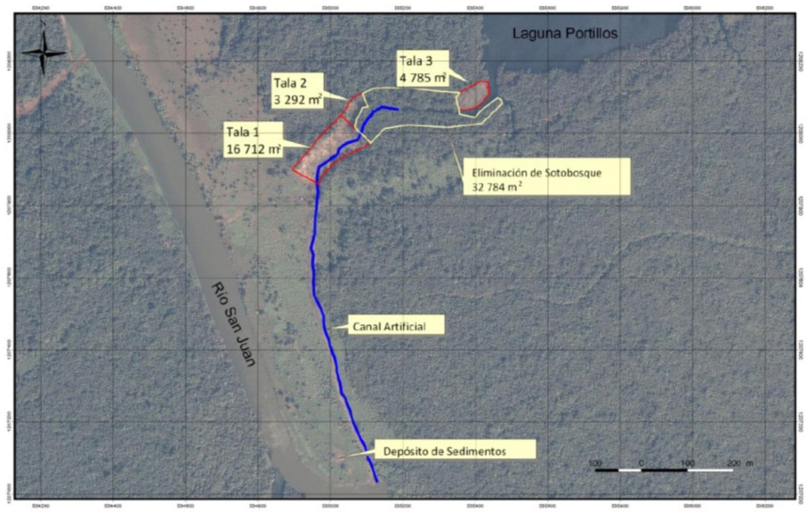

Figure 8- Deforested, Undergrowth Elimination, Artificial Channel and Sediment Deposit Areas on 2011 Photo. Source: Adapted from Araya 2011b by ACTO.

undergrowth vegetation was cleared. It shows the 3 areas where primary forest was cut (Tala 1, Tala 2 and Tala 3), an area of undergrowth clearing (eliminación de sotobosque); the path of the artificial canal (canal artificial), and an area where sediments from dredging were deposited (depósito de sedimentos) (Figure 8).

The completely deforested areas are typically populated by tree and palm species adapted to high levels of humidity dominated by *Raphia taedigera and Pterocarpus officinalis* characteristic of the association called "Yolillal". Two fronts of deforestation are evident: a smaller one next to Portillos Lagoon (Tala 3) and the other one further southwest about 300 meters away from San Juan River (Tala 1 & Tala 2). The first inspection (10/2010) showed that this area had very recent clear cutting in about 1.67 hectares and a total of 197 trees (as shown in Table 4) with diameters between 5 and 130 cm. The second inspection showed an increase of almost 1 hectare up to about 2.48 hectares of deforested area.The front closer to San Juan River (west front) grew from 1.67 ha to about 2 ha (Tala 2), while the almost half hectare next to Portillos lagoon was all cleared after the October inspection (Tala 3). For the April inspection about 60% of the area that had been cut by October had been fully used to the point of having eliminated the stumps down to the ground.

Residues of saw dust indicating milling activity were found. Site characteristics indicated that the removal of trees could be dated back to two weeks before October 25. On April, most of the stumps had shoots of heights between 50 and 100 cm that indicated having been cut about five months before. Figure 9 compares a satellite image from August 8, 2010 with another satellite image of the same area from November 12, 2010 in which the perimeter of the deforested areas (Tala 1, 2 & 3) is indicated, demonstrating the approximate date of tree removal. (Araya, 2011b).

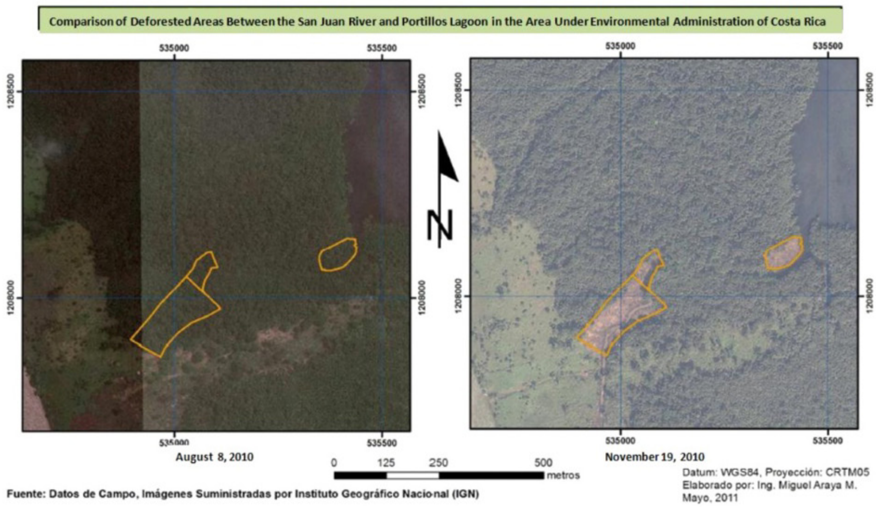

Figure 9- Comparison of Cover in Different Dates of the Area of Recent Cutting (1). Source: Adapted from Araya 2011b.

The report states that in April 2011 detailed information gathering was not possible due to the obstruction of apparent Nicaraguan environmentalist citizens. Therefore, the number of trees cut in the new areas was extrapolated proportionally from the previous data. This extrapolation assumes a proportional increase in trees with similar characteristics as the data from October of around 1.5 times (292.7 trees). The losses in carbon in the biomass would therefore increase to around 312,124.005 kg. This amount converts to 1,144,454.69 Kg of CO_2 or the equivalent in this greenhouse gas to the typical emissions of 208 passenger cars in one year according to estimates of the United States Environmental Agency for 2005 (EPA, 2005).

The area of undergrowth clearing (eliminación de sotobosque) is similar in species as the areas of complete deforestation (both fall under the classification of marshes on inorganic soils, specifically freshwater, tree-dominated wetlands (Xf). It has the shape of a rectangle and it borders with the cleared areas on both sides and Portillos lagoon partially on the east. In it all minor vegetation was eliminated and only some stumps and mature trees were left mostly *P. officinalis.*. Permanent water mirrors were observed which indicate that the removal of vegetation affected hydrological protection areas (Araya, 2011b).

In October 2010 the artificial canal did not exist yet, but an alley of about 496 meters was introduced in a deforested area. By April 2011 this alley gave way to an artificial channel of about 860 meters in areas with no forest and goes on northeast for about 500 meters more through areas of complete deforestation and undergrowth cut. The other area marked in Figure 8 is where sediments extracted from dredging the San Juan River were deposited (Araya 2011b).

Based on the work of prestigious research centers and NGOs in Costa Rica (CATIE, University of Costa Rica, the Technological Institute of Costa Rica, FUNDECOR and CODEFORSA) Araya 2011b makes an estimation of the time of recovery for the areas damaged taking into account species distribution, species growth rates per year, flooding conditions and other limiting factors of the site. It concludes that the recovery time may be at least 50 years to have a forest with a similar structure as the one that was cut with the upper canopy dominated by *Pterocarpus officinalis* with a diameter close to 30 cm and a mid canopy dominated by *Raphia taedigera.* Growth rates show that in order to have trees with diameters above 1 meter it would take a recovery time of between 200 and 250 years. 2.5% of the trees in the cut area were found to have diameters above 1 meter since the October inspection.

In relation to the ecological consequences identified by RAMSAR Mission 69, Araya (2011b) evaluated the changes in ecological characteristics at that time. It found that there was no evidence of continued excavation of the artificial channel or deforested areas beyond the ones already identified. Shrub colonization was observed. It states that a possible induced obstruction of the channel could diminish the drainage of flooded areas that is happening and re-establish soil humidity conditions similar to the ones existing previous to the construction of the channel. Diminishing this drainage effect would prevent the changes forecasted in the long term by Mission 69. Further it concludes that continued human presence on the area is a factor that would hamper the recovery process. The report concludes with recovery technique and monitoring recommendations.

VI- Remaining Challenges for the Conservation of the CNW: Economic Valuation, Community Participation, Bi-national Cooperation and Technical Supervision

As part of a public awareness process, the state of current ecosystem service losses can be economically valued as an indicator of the ecological-economic significance of such damage to the wellbeing of the neighboring area, the country and the world. Fundación Neotrópica has already contributed in this process with two reports (Aguilar-González & Moulaert-Quirós, in review (b), Aguilar-González and Moulaert-Quirós, unpublished).

The monetary ecological economic methodology used in those studies is based on the most accepted approach to quantifying environmental losses in order to make them comparable. These ideas are formalized in the Total Value Equation (TVE). TVE estimation techniques depend on the available information. They range from simple valuation (when prices are available) to shadow pricing and survey based approaches (relying mostly on contingent valuation methods). Shadow pricing methodologies include the benefit or value transfer methodology, which consolidates monetary economic valuation data from peer reviewed academic journal articles in order to estimate, through land use data, a high and low dollar value range for a list of ecosystem services (according to an estimate of them being in optimal or suboptimal conditions) for the ecosystem in question, according to the size of area in different land uses. It therefore adapts to a context under examination the estimates from another context. It is mostly used when it is too expensive or there is very little time to conduct an original valuation study, yet some measure is needed.

This methodology was used for Aguilar-González & Moulaert-Quirós (in review(b)) and has been used for well known peer reviewed articles such as the seminal work of Costanza, et. Al *The Value of the World's Ecosystem Services and Natural Capital (1997)*. It is also widely used in the United States by prestigious Non Governmental Organizations such as Earth Economics and the world known Gund Institute for Ecological Economics of the University of Vermont. It was also used for the UNEP sponsored *"The Economics of the Environment and Biodiversity"* (TEEB, 2010) recently released.

A mixture of this methodology with other shadow pricing techniques and direct valuation was used for Aguilar-Gonzalez & Moulaert-Quirós´s (unpublished) estimate of direct losses based on the inventory of trees cut in Araya (2011a). Yet, both reports acknowledge these estimates as provisional (mostly due to urgency) as they advise that more direct and participatory methods should be implemented. These would solve the abstraction, contextual and non-participatory limitations of benefit transfer and other TVE estimation methods through the integration of multiple criteria (including cultural and biophysical considerations) validated by all relevant stakeholders.

In fact, more community and organized civil society participation have been a constant recommendation of Fundación Neotrópica in this conflict. Its experience with community wetland conservation has demonstrated in other important wetland areas of the Osa Peninsula in Costa Rica that participation at both the advocacy and direct execution levels can be an effective method for environmental conflict resolution.

The area of the Barra del Colorado Wildlife Refuge (northern part of the CNW) is inhabited by close to 15 communities (the main of which appear on Figure 10). The socioeconomic characteristics of these populations point to a low quality of life due to non-satisfaction of basic needs such as employment, education, health, potable water, access infrastructure and communications to which drug trafficking related illegal activities have been added lately. Its main economic activities are very natural resource dependent: agriculture and animal husbandry, commercial fisheries and hunting. These activities have not been fully controlled leading to some ecosystem damage. By the same token, damage to the ecosystems directly affects the livelihoods of these communities (ACTO, 2010).

Figure 10- Main Communities (marked in orange) Located Close to and Within the Protected Areas (Barra del Colorado Wildlife Refuge) that are Part of the CNW. Source: Adapted from Maps from Costa Rica´s Digital Atlas by the ITCR.

As can be seen also in Figure 10, the colonization front is very close to the southwestern border of this area. These communities are also very dependent on the ecosystem services provided by the protected area.

It is also worth emphasizing that the spirit of the March 8, 2011 resolution by the International Court of Justice leads in the direction of establishing more trans-boundary cooperation and a permanent international monitoring team in order to ensure that this type of occurrence is not repeated. In view of the results of the inspections done in the area under environmental administration by Costa Rica, it seems that such recommendations acquire more validity.

VII- Brief Conclusions

Costa Rica and Nicaragua both have extremely rich natural endowments and their own level of socio-ecological challenges to be able to conserve them adequately. The opening of a channel in the Portillos (Calero) Island region by the Nicaraguan government and the clearing of wetland forests in the same area (about 2.48 hectares of clear cutting plus other types of impacts in other areas) have created a conflict between these two neighbors under allegations of sovereignty and environmental damage. This conflict was brought to the jurisdiction of the International Court of Justice of the Hague which in the interim of coming to a final decision resolved the petition by Costa Rica for provisional measures on March 8, 2011, ordering an exclusion zone in the area north-northwest of the channel that Costa Rica claims never existed which it calls “disputed territory”. Recognizing the importance of RAMSAR it ordered an additional provisional measure whereby, given the fact that it considered plausible that the Direct Impact Area has belonged to Costa Rica for over 100 years, it gave Costa Rica environmental administration of this area.

The international scientific community has recognized in the latter years that wetlands are among the most important ecosystems for climate change reduction, mitigation and adaptation due to their high potential for GHG regulation (Table 1). It labels these as blue carbon sinks. In the case of the wetlands in the conflict area we have wetlands that are in a transition area between coastal and inland ecosystems. The large carbon sequestration capacity of coastal habitats arises in part from the extensive belowground biomass of the dominant vegetation. Sustaining blue carbon sinks will be crucial for ecosystem-based adaptation strategies that reduce vulnerability of human communities to climate change. Halting the decline of ocean and coastal ecosystems would also generate economic revenue, food security and improve livelihoods in the coastal zone

This international recognition of the importance of wetlands and the border ecosystem conflict with Nicaragua have brought about an increased awareness and self critical process pointing to the challenges that are necessary to overcome in order to effectively conserve wetlands in Costa Rica. In spite of an abundant regulatory framework, its effectiveness is under serious scrutiny and in need of financial support to overcome its lacks. The support of NGOs is evident and can prove to be fundamental in this process both from the technical support standpoint and to secure the participation of the civil society as a necessary stakeholder.

The RAMSAR mission 69 report from December 17, 2010 and the UNOSAT report from January, 2011 provided the first technical and impartial assessments of the actual and potential ecosystem service losses caused by the actions of the Nicaraguan losses. The RAMSAR Report defined a direct (225 ha) and an indirect impact area (approximately 21,500 ha). It created scenarios for the short, medium and long term for both areas, considering serious potential losses in ecosystem services as reported In Table 3. It recognizes that, from these services, flood control, recharge of the water table, sediment and nutrient retention, water purification, biodiversity and wetland products such as sport and subsistence fisheries, hunting and forest products and recreation for tourism could be highlighted at the CNW as particularly at risk. The UNOSAT report verified most of the actions that have caused the ecological changes evaluated by the RAMSAR report, illustrating the dynamics through time between August and December 2010.

The site inspection reports by ACTO personnel from October and April provide a detailed assessment of the direct damage in ecosystem services caused with evidence of the time of the damage being consistent with the timing of the allegations of the Costa Rican government to the International Court of Justice. It documents the areas of impact comprised by the deforestation of primary forest, the clearing of undergrowth, the artificial canal and the deposition of sediments. (Figure 8).

The reports conclude that the average age of the trees removed was 115 years with a total number of trees removed of 292.7. The losses in carbon in the biomass would therefore be around 312,124.005 kg. This amount converts to 1,144,454.69 Kg of CO_2 or the equivalent in this greenhouse gas to the typical emissions of 208 passenger cars in one year according to estimates of the United States Environmental Agency for 2005.

The reports also conclude that the recovery time may be at least 50 years to have a forest with a similar structure as the one that was cut with the upper canopy dominated by *Pterocarpus officinalis* with a diameter close to 30 cm and a mid canopy dominated by *Raphia taedigera.* Growth rates show that in order to have trees with diameters above 1 meter it would take a recovery time of between 200 and 250 years. 2.5% of the trees in the cut area were found to have diameters above 1 meter since the October inspection.

In relation to the ecological consequences identified by RAMSAR Mission 69, the reports concluded that there was no evidence of continued excavation of the artificial channel or deforested areas beyond the ones already identified. Colonization by shrubs was observed. It states that a possible induced obstruction of the channel could diminish the drainage of flooded areas that is happening and re-establish soil humidity conditions similar to the ones existing previous to the construction of the channel. Diminishing this drainage effect would prevent the changes forecasted in the long term by Mission 69. Further it concludes that continued human presence on the area is a factor that would hamper the recovery process.

An adequate participatory ecological economic ecosystem valuation process can be an important tool for awareness on the severity of the damages caused. Several estimates have been already done by Fundación Neotrópica and the University of Vermont´s Gund Institute for Ecological Economics with the purpose of helping advance this goal. Yet they still contain preliminary estimates based on methodologies that can be improved by community participation and better on the ground data collection.

Community stakeholder participation is not only desirable but necessary for the full resolution of this conflict as many neighboring communities are dependent on the ecosystem services found in the conflict area, its DIA and IIA. We highlight the spirit of the March 8, 2011 resolution by the International Court of Justice in the direction of establishing more trans-boundary cooperation and a permanent international monitoring team in order to ensure that this type of occurrence is not repeated in the future in these important protected lands.

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DOCUMENTS SUBMITTED BY NICARAGUA TO THE COURT DURING THE HEARINGS ON PROVISIONAL MEASURES

Annex 158

Corea y Asociados S.A. “Environmental Impact Study for the improvement of Navigation in the San Juan River of Nicaragua”, (excerpts) pp. 6, 18 and 24.

September 2006

EXCERPTS FROM PROJECT DESIGN FINAL REVISED REPORT

Environmental Impact Study for the improvement of Navigation in the San Juan River of Nicaragua.

Corea y Asociados S.A., September 2006

(Excerpts)

(…)

For Nicaragua, it is vital to improve the conditions for navigation in the section Delta - San Juan de Nicaragua. This requires deepening the river bed at 2.0 m and a width of 30 meters, hence, eliminating the current impediments and delays and thereby facilitate the permanent and safe navigation of vessels of private and public transport running through the section from San Carlos to San Juan de Nicaragua. (p. 6)

(…)

The transfer of a cutter and suction dredge will be used to dredge the riverbed in the proposed section; can only be possible strategically and economically through the Caribbean Sea. This type of equipment, for its capacity and size, does not exist in Nicaragua, making it necessary to hire a dredging company with the ability and experience to undertake the work. Therefore, the cutter and suction dredger expected for this type of work must be brought from a foreign country or the possibility that the equipment is available in the region. (p. 18)

2.2.6 Barriers to protect the banks of the San Juan River

During the field studies performed, some locations on the banks of the river were seen to continuously flow over the banks, possibly due to the type of soil, the current, the waves produced by outboard motors with capacity higher than 40 HP, the trees and trunks that the current conveys, etc. This also causes sedimentation, in addition to the sedimentation carried by the river, forming numerous islands and sandbanks in this sector. It is necessary to protect those sites against erosion, otherwise, with the new channel design, the situation may worsen.

In order to protect sites that are generally located in narrow areas where large islands are forming that reduce the space of the channel, slightly increasing current speed, such as Isla Salomón, Taura, etc., we are recommending the construction of a protective barrier on the banks of the river.

The protective barrier on the banks of the San Juan River consists of the following:

Construction of a structure or physical wall that does not allow erosion along the riverbanks, meaning that it must be impermeable, continuously retaining erosion or flooding that occurs during times when the river rises. It must be firm and solid, easily and quickly built, it must be built prior to or in parallel with the dredging process so that the dredged material can be used to fill the empty sections of the barrier.

2.2.7 Barrier construction process

First, galvanized metal pipes are driven into the ground, sheet no. 20, 4 inches in diameter, with embedded length of 2.5 meters and 2.0 meters of free space, which coincides with or exceeds the height of the edge, and these pipes will be spaced every 1.20 meters, reinforced with another pipe as a bracket at a 30° angle every 5 pipes, that is, every 6.0 meters. Then tension cables 3/8" in diameter will be put into position, joining the upper part of those pipes at the middle and lower sections of the pipes, passing inside a metal band ½" in diameter, welded onto the pipe. Then the same metal cable is placed diagonally across the spaces between the pipes, from the upper part of the pipe to the lower part of the pipe on the riverbed, with proper tension, and it is secured and aligned with the pipes.

Once the securing structure is ready, an 8-foot cyclone-type metal screen is put into place with proper tension, and it is tied with metal wire no. 16 to the metal cable, resulting in a firm, rigid and very resistant structure.

LOCATION OF THE SITES EVALUATED FOR DEPOSITING MATERIAL

No.	DEPOSIT SITE	UTM COORDINATES NORTH	EAST	AREA (M^2)	VOLUME m^3
1	Public Property	1210113	205751	11.25	0.00
2	Public Property	1207775	207232	1.82	0.00
3	Public Property	1207319	207736	2.08	14,579.00
4	Juan Popa	1206796	207353	15.73	110,532.00
5	Public Property	1205357	207314	5.61	39,404.04
6	Chepe Huevo	1204649	208162	1.19	16,744.98
7	Daniel Reyes	1203662	208278	13.39	188,184.00
8	Noel Castillano	1202463	207727	2.13	29,958.00
9	Calixto	1201429	207534	14.65	102,941.00
10	José Gómez	1199981	207762	4.73	66,436.00
11	José Gómez	1198453	208250	27.41	192,571.00
12	Alejandro Reyes Aragón	1197832	208809	19.22	135,019.00
13	Socorro López S.	1196615	208689	9.01	63,283.00
14	Dário Sánchez	1194306	205891	2.40	33,700.00
15	Ricardo Salinas	1194453	203651	1.86	26,090.00
16	Silvio Reyes	1193900	202322	25.16	0.00
17	Rubén Reyes	1193247	200549	13.73	363,801.00
18	Felipe Espinoza	1193136	199890	5.34	75,074.00
19	Gregorio Chamorro	1192607	198443	0.52	7,334.00
20	San Juan River Delta	1192386	197532	1.19	0.00
21	Public Property	1192429	197088	1.30	0.00
22	Public Property	1192535	196203	0.39	5,544.00
23	Public Property	1191939	194134	1.20	16,874.00
24	Public Property	1189857	189947	6.65	46,742.00

Annex 159

Ministry of Environment and Natural Resources of Nicaragua (MARENA), "Specific Terms of Reference for the Preparation of the Environmental Impact Study for the Project 'Dredging of the San Juan River"

ANNEX 5

[logo]
Government of Nicaragua
Ministry of the Environment
and Natural Resources
MARENA
Department of Environmental Quality

SPECIFIC TERMS OF REFERENCE FOR THE PREPARATION OF THE ENVIRONMENTAL IMPACT STUDY FOR THE PROJECT "DREDGING OF THE SAN JUAN RIVER"

CONTENTS OF THE ENVIRONMENTAL IMPACT STUDY

General Aspects

I. LEGAL AND REGULATORY CONSIDERATIONS

The consultant should frame the project in terms of the economic and political development of the country. Pertinent legal documentation will be analyzed, and the laws that will affect the project will be investigated; these include, but are not limited, to labor laws, those for the protection of geographic, environmental and municipal spaces, quality standards, technical standards, and environmental standards; protected and sensitive areas; protection of endangered species; use and control of marine and lake areas; and international agreements. In the absence of national legislation, international legislation will be used as a guide.

The consultant should consider that the site where the project will be developed is recognized as a wetland of international importance...under the Convention on Wetlands (IRAN, 1971) known as the RAMSAR Convention.

II. DESCRIPTION OF THE PROJECT AND ITS ALTERNATIVES

2.1 General Description of the Project

2.1.1. Position: Determine the department and municipality, as well as the area identified for the development of the project, detailing the extension and delimitation of the same.

2.1.2. Location: Locate on a geo-referenced plane, with UTM coordinates, the area of study and the area in which the project will be located, including on the plane basic information such as: contour, etc. and delimitation of the areas that will be involved (1:1,000 and 1:500 scale maps).

2.1.3. Justification for the Project: Indicate the facts that support the need to develop the project, current demand in the regional and national contexts, the good or service offered, considering the rehabilitory effects on the hydro-biologic connectivity of the San Juan River, which will benefit the migration of euryhaline species.

2.1.4. Objectives: General and specific objectives of the project and of the Environmental Impact Study.

2.1.5. Present the plan for each surface that will contain one of the works (scale of 1:1,000, 1:500).

2.2. Description and Technical Characteristics of the expansion of dredging activities

Develop a detailed description of the activities, methodologies, and processes to be utilized in every phase of the project, indicating the location where each activity will be conducted, as well as the technologies, logistics, equipment, supplies, goods and services that will be required. The following activities should be described:

2.2.1. Technical description of the dredging and expansion:

• Configuration of the riverbed (cross sections every 500 meters at most)
• Configuration of minimum depths
• Geometric design, channel alignment, depth of the channel
• Identification of the areas to be dredged
• Quantity and physiochemical quality of the material to be dredged (granulometry, concentration in
sediments of chlorinated organic chemical compounds, pH, heavy metals (Cd, Cr (total and hexavalent), Pb, Zn, among others). The sampling locations should match the geodetic points (BM) used by INETER.
• Description of the dredging techniques and methods both during the performance of the project and during the maintenance of the channel.

2.2.2. Processes, machinery and equipment

Present the information on the machinery and equipment to be utilized, indicating its principal technological characteristics, including but not limited to: size, capacity, performance, service life, fuel usage, energy and vibration.
Describe the processes, requirements and schedule of operation and maintenance for the machinery and equipment to be utilized.

2.2.3. Fuel supply: Fuel volume, and techniques for storing and supplying fuel to the dredge.

2.2.4. Waste management:

Describe and present in detailed lists the estimated volumes of solid wastes, oils generated by the dredging machinery and equipment, and the filters and fibers used in any activity to be conducted during the development of project, and the management alternatives, indicating as well the final deposit sites.
Describe the activities and type of discharges (liquid, solid, and gaseous) that will affect water quality, as well as the municipal, agriculture, livestock, mining, and agro-industrial contributions.

2.2.5. Management of dredged material:

• Identification of the sites for the final depositing of the dredged material.
• If heavy metals are present in the sediments, bioavailability and theoretical bioaccumulation potential should be evaluated.

• If heavy metals are present, perform modeling of metal discharges according to the type of dredge and final deposit site, analyzing the movement of sediments and the impact on the water column.
• For deposition on land, alternative sites must be presented, including their volumetric capacity, drainage controls, water retention time, maximum allowable concentration of solids, and additional work for sediment retention.
• If the deposition is in the ocean, the selection of proposed site must be justified.
• Methods for transporting to final deposition sites, pumping methods, use of floating structures.

III. DESCRIPTION AND ENVIRONMENTAL CHARACTERIZATION OF THE AREA OFINFLUENCE

3.1. Border of the Area of Influence:
Characterize the potentialities and vulnerabilities of the study area without the project, before the activities take place that will transform them (directly and indirectly). Serve as a baseline to characterize the action area before it is affected by the project, in order to identify the potential impacts on the study area.
The geographic limits the area to be influenced both directly and indirectly by the project should be defined.

3.2. Abiotic Environment
This section should describe the physical characteristics of the project's area of influence. Geological characteristics of the area, with an emphasis on the tectonic, stratigraphic, geomorphologic, seismic (seismic zoning) aspects, as well as climatology and meteorology, emphasizing the probability and frequency of hurricanes and the presence of contamination sources (fixed and mobile).

3.2.1. Geology and Geomorphology
• Description of the geomorphology and sedimentology of the project's area of influence.
• Analysis of the sedimentologic processes, and the size, color, odor, and presence of fats and oils in the particles of the riverbed.
• Results of the bathymetry in the area.
• Identify the natural drainage networks in the area of influence
• Identify the erosion and sedimentologic processes in the channel and the natural erosion and stability controls on the banks

3.2.2. Soil: If the dredged materials will be deposited on land, the following must be presented:
The current and potential use of soils, identifying the compatibility of uses, including the corresponding cartographic representation of these two aspects. In the areas

likely to be affected by the project, the physico-chemical characteristics (depth, permeability, porosity, humidity, texture, structure, pH, cation exchange capacity and base saturation, alkalinity) and the capacity and adequateness for soil use should be determined. The edaphic characterization of the soil will be the reference point for the restoration of the areas affected by the project.

3.2.3. Hydrology:

• Dynamics, flow, velocity of the river in the section to be dredged
• Hydrographic description of the project area, with information on the hydrological conditions of sediment contributing rivers and other waterbodies, channels and outlets to the sea.
• Analysis of water quality, salinity (for delta zones), temperature, dissolved oxygen, pH, color, transparency, oils and fats, dissolved solids, total solids, DBO, DQO, pesticides, and the presence of contaminants, among other parameters.
• Define the current uses of the waters of the San Juan River (ecological, human consumption, fishing, watering hole, irrigation, and touristic, among others).
The analysis of water quality in the area should be conducted in estuarine waters and in the surface waters, in order to have a baseline study establishing the existing quality of the waters in the project area.
If deposit sites are planned in the ocean, the ***Dynamic Marine Behavior*** should be described.
• General System
• Bathymetry
• Coastal Transport System
Circulation and patterns of Marine Currents
Depth
• Composition of the Sea Floor
• Physico-chemical composition of the substratum of the sea floor
Physical-chemical characteristics of the waters

3.3. Biotic Environment (Flora, Aquatic and Terrestrial Fauna)

Based on existing information, characterization of the ecosystem in which the project will be developed, describing the existing vegetation and fauna, identifying habitat, nesting and breeding grounds for species of aquatic fauna, protected species, and ecological connectivity.When areas of land are to be utilized (removed, eliminated or cut) for the deposition of dredged materials and this use is not itself a forestry use, the following information should be provided:
Describe the plant coverage, expressed as forests (primary, secondary), bushes, crop residues, forest plantations, agri-silviculture systems, pastures, natural grasslands, or isolated trees. Georeference with their respective locations in plans with a detail scale of 1:10,000.

Estimation of the areas to be affected if the dredged material is deposited on land adjacent to the channel of the river, and specify when it is to be within a protected area.

3.4. Socio-Economic Environment:

During the elaboration of the Environmental Impact Study, for the project's direct area of influence, the levels of participation should be taken into account in accordance with the national legislation in force.
Information on the project and its implications in the area of study should be provided. Based on existing information, a characterization of the following should be conducted:

3.4.1. Municipal Characterization

The current political-administrative structure of the municipalities involved in the project's direct area of influence should be described as well as the structures of population centers, communities surrounding the project, land management, social facilities (schools, hospitals, health centers, hotels and ports, among others).

3.4.2. Population

Characteristics of the density of the current and predicted populations, urban-rural distribution, age and gender composition, growth and migration trends, economically active population, income level, distribution of active population by activity sectors, indigenous peoples, residents in the project's area of influence.

3.4.3. Economy

Perform a characterization of the established economic activity in the area of influence, indicating occupational distribution and the interrelationships between different activities that constitute the economic structure of the subject areas.

3.4.4. Road Network

Identify roads located in the project's area of influence and the different modes of transportation used by the population and for goods and services.

3.4.5. Historical and Cultural Heritage

Identify and characterize the sites considered to be aspects of the historical and cultural heritage of the project's area of influence (archeological sites, historic cultural monuments), in order to prevent dredged materials from being deposited in sites that contain archaeological or historical artifacts.

IV. IDENTIFICATION, EVALUATION AND ANALYSIS OF ENVIRONMENTAL IMPACTS

4.1. Identification of Impacts

Identify and describe the impacts potentially caused by the actions, activities, tasks and work to be conducted as part of the project, and the cause-effect relationships, and evaluate the magnitude and importance of the same, in every environment (physical or abiotic, biotic, socioeconomic and cultural).

In this chapter, the procedure and techniques used for the identification of impacts should be presented.

The impact assessment should preferably be conducted based on quantitative and qualitative methods.

Whenever possible, quantify future environmental quality in terms of values calculated using simulations or models such as (but not limited to): gas dispersion models, and models of the dispersion of pollutants in the sea and rivers.

Emphasize the following aspects, without limiting the analysis to them:

• Impact on the hydraulic dynamics of the San Juan River;

• Impacts on water quality caused by the resuspension of sediments in the water column;

• Mobilization of chemical compounds and other dangerous soluble substances contained in riverbed sediments into the water column;

• Attraction of occasional species and impacts to benthic communities;

• Ecosystem losses, the alteration of aquatic habitats, and harm to fishing;

• Impact on emblematic endangered and economically important species (manatee, shark, lizard, sea bass, gaspar [fish], and river shrimp); and

• Impacts stemming from the deposition of dredged materials.

4.2. Evaluation and analysis of the impacts

For this task, analysis methods available to the designer of the project should be utilized, and they must be explained in detail so that they can be understood.

Define the following:

a) Methodology utilized

b) Identification of the project Actions and the Components of the Environmental System

c) Identification and Description of the Environmental Impacts of greatest relevance that will be mitigated based on the evaluation.

V. ANALYSIS OF RISKS:

5.1. Analysis of risk: Based on nationally and internationally accepted methodologies and procedures, as well as existing information, analyze the probability of occurrences resulting from natural and human phenomena, identifying the potentially affected areas.

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Government of Nicaragua
Ministry of the Environment
and Natural Resources
MARENA
Department of Environmental Quality

GENERAL GUIDELINES
FOR THE PREPARATION OF THE ENVIRONMENTAL IMPACT STUDY FOR THE PROJECT "DREDGING OF THE SAN JUAN RIVER"

I. OBJECTIVE

Provide the technical elements necessary to orient the multidisciplinary group charged with the formulation of the Environmental Impact Study so that all important aspects will be integrated in the review of the potential impact of the works and activities of the project "**DREDGING OF THE SAN JUAN RIVER**," in accordance with what is established in the procedures outlined in subsection j of Article 5 of Decree 45-94, which establishes the applicable procedures.

II. GENERAL GUIDELINES AND REQUIREMENTS FOR THE PREPARATION OF THE EIS

1. The preparation of the Environmental Impact Study (EIA) and the Environmental Impact Document will be carried out under the direct responsibility of the proponent, and it should be conducted by a qualified consulting firm, comprised of a group of professionals with work experience in the environmental area. Throughout the development of the study, clarifying meetings can be conducted between the regulators (MARENA, MTI, INETER) and the proponent.

2. The technical description of the project should provide the geographic coordinates of the area where the project is to be conducted, as well as the name given to the project by the proponent.

3. Given the dimension of the project, and to aid in clarifying the information and its analysis, the Environmental Impact Study should contain only pertinent information and present it in a progressive fashion, highlighting fundamental aspects, for which the following is recommended:

• Avoid ambiguous or subjective comments; everything expressed should be based on accepted and valid criteria, standards, records, and data.

• The language utilized should be the same throughout the whole EIA in order to ensure uniformity in linguistic criteria and coherence between each chapter of the EIA that is developed.

• In the preparation of the EIA, a harmony of terms should prevail, so acronyms should be utilized, a glossary developed, the International System of units (SI) utilized, aerial photos [provided], and references to geographic location should be made with geographic coordinates.

• The original and (5 copies) of the Environmental Impact Study and 6 copies of the Environmental Impact Document should be provided, signed by the proponent, its legal representative, and all the members of the multidisciplinary team responsible for their preparation.

III. ENVIRONMENTAL IMPACT DOCUMENT

The Environmental Impact Document should be prepared, and provided for public comment by the affected population, and to the governmental organizations and other interested social groups, with the goal of informing and clarifying any doubts regarding the aspects and actions of the project and to learn the opinions of the population.

The Environmental Impact Document should translate the results of each of the activities and works of the Environmental Impact Study into language that is simple and easy for the population to understand. This document should contain a summary of:

3.1. Executive Summary

3.2. Description of the Project (location, objective, justification, and scope of the project)

3.3. Characterization of the project's area of influence

3.4. Description of the activities to be conducted and the positive and negative impacts that will be caused by each of those activities

3.5. Present plans on the geometry of the river channel

3.6. Management of the dredged material

3.7. The proposed environmental measures to prevent, mitigate or compensate for the negative impacts

3.8. Environmental Management Program

4. PUBLIC CONSULTATION

The whole project will be subject to public consultation, in accordance with what is established in the terms of reference prepared by the technical team, classified in two types:

a. Availability of the Environmental Impact Document in previously established sites (location or locations in which the project or activity will be carried out) in a location accessible to the public, for all of the activities established in Decree 45-94.

b. Presentation of the Environmental Impact Document (DIA) by the proponent and on-site discussion determining the participants in the process (at the national or local level), inviting the different sectors interested in the project to participate.

In this case, it is determined that the public consultation for the project "**Dredging of the San Juan River**" will be conducted per the procedure outlined in subsection a.

5. INFORMATION ON THE MEMBERS OF THE TEAM

Include the following information regarding the members of the team that participated in the preparation of the Environmental Impact Study.

i. Full name

ii. Telephone & fax

iii. Profession

iv. Environmental Impact Studies in which they have participated, indicating the name of the project, business, proponent, and date

v. Signature and identity card number

Annex 160

Ministry of Environment and Natural Resources of Nicaragua (MARENA), DGCA Administrative Resolution Ref: No. 038-2008,

22 December 2008

ANNEX 8

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DIRECTORATE GENERAL OF ENVIRONMENTAL QUALITY

ADMINISTRATIVE RESOLUTION No. 038-2008

Following examination of the application for an Environmental Permit dated the 25th day of January two thousand six, filed by the Empresa Portuaria Nacional company (EPN), for execution of the ***"Improvement of Navigation on the San Juan de Nicaragua River"*** project, the record for which is identified as Record Number 037-2006, before the Ministry of the Environment and Natural Resources, Directorate General of Environmental Quality. The project consists of the design and construction of a navigation channel by means of the dredging of 41,963.57 linear meters of the section extending from the site known as Punta Chingo Petaca to the mouth of the San Juan de Nicaragua River, and the construction of an access canal permitting the movement of dredge from the Caribbean Sea to the San Juan de Nicaragua River, which shall have a length of 2,000 meters. The project is located in the jurisdiction of San Juan de Nicaragua Municipality, Río San Juan Department, within the boundaries of the San Juan de Nicaragua River Wildlife Refuge.

In response to this application, notices were sent to the agencies involved for the creation of the inter-institutional group responsible for evaluating the project and issuing a technical determination therein, in accordance with the established procedures, in which representatives of the Office of Executive Secretary of the Southeast Nicaragua Biosphere Reserve, the Nicaraguan

Institute of Territorial Studies (INETER), the Directorate General of Water Transport of the Ministry of Transportation and Infrastructure (DGTA – MTI), and the MARENA San Juan River Territorial Delegation participated, with coordination by the MARENA Directorate General of Environmental Quality.

Three technical inspections were performed in the area of the proposed project, with the participation of the inter-institutional group and the project's representatives.

The Terms of Reference for the formulation of the Environmental Impact Assessment (EIA) were drawn up, the first preliminary and detailed technical reviews of the EIA and the Environmental Impact Document (EID) were carried out, and the required meetings with the inter-institutional team and the project's representatives were held to clarify technical aspects reflected in the Terms of Reference, as well as in the period of detailed technical review of the Environmental Impact Assessment and the review of Addendum I.

The Public Comment process was conducted during the period from Wednesday 9 August to Tuesday 15 August 2006, and comments and remarks were received from five individuals, as well as from the Director of the Office of Executive Secretary of the Southeast Nicaragua Biosphere Reserve and the Municipal Mayor of San Juan de Nicaragua. All the comments were analyzed and considered in the Administrative Resolution by the

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Inter-institutional team that issued a determination on the Environmental Impact Assessment submitted by the Proponent.
In response to the substitution of authorities at the EPN following the election of two thousand six, the request for complementary information by the institutional evaluation team, to correct certain weaknesses found in the EIA, was sent to the MARENA by the EPN's new authorities.
All the requests were fulfilled and the procedure for the corresponding environmental impact permit was resumed.

WHEREAS

I

The Political Constitution of Nicaragua prescribes the right of all Nicaraguans to live in a healthful environment, and the Nicaraguan State is responsible for ensuring this right through the implementation and use of environmental management arrangements and instruments. The Ministry of the Environment and Natural Resources is the agency charged with formulating, proposing, and directing the national environmental policies.

II

Law 217, General Environment and Natural Resources Act, provides as follows in its Article 4, part 3: *"The criterion of prevention shall prevail over any other in the public and private management of the environment. The absence of absolute scientific certainty cannot be invoked as a reason for not taking preventive measures in all activities which have an impact on the environment."* Additionaly, Article 4, part 5, provides that: *"Property rights have a social and environmental function which limits and conditions their absolute, abusive, and arbitrary exercise, in conformity with the provisions of this act and the special environmental laws in force."*

III

The Regulations on Protected Areas of Nicaragua (Decree No. 01-2007) provide in their Article 51 *"that the works, activities, and projects to be carried out in the protected areas which require environmental permits must be in accordance with the procedures prescribed for them, the approved Management Plans, and the technical criteria for conservation of their natural resources biodiversity, landscapes, habitats, and ecosystems so as to ensure the continuity of the ecological and evolutionary functions and processes in the protected areas."*

IV

The provisions of Law 585, Prohibition of Cutting, Utilization, and Marketing of Forestry Resources Act, published in Official Daily-Gazette No. 120 on the twenty first day of June, two thousand six, and the provisions of Law 620, General National Waters Act, and its Regulations, published in Official Daily-Gazette No. 169 of the fourth day of September, two thousand seven, prescribe measures, restrictions, and prohibitions in the field for each legal instrument, which cannot be reflected in the provisions of this Environmental Permit because they are Laws which entered into force subsequent to the application, in fulfillment of the principle prescribed in Article 38 of the Political Constitution of Nicaragua, whereby "The Law has no retroactive effect …."

V

The San Juan River is the only communication route at the disposal of San Juan de Nicaragua Municipality, wherefore the improvement of that river's navigability is of vital importance to satisfy the basic needs of said municipality's inhabitants.

VI

The current degree of sedimentation in the last section of the San Juan River, from Punta Chigo Petaca to the San Juan River's mouth, poses serious problems for navigation, which impedes the entire San Juan de Nicaragua Municipality's full participation in the national life, impairing the entire population's access to basic public services and the enjoyment of their rights as Nicaraguan citizens which are conferred on them by the Political Constitution of Nicaragua.

VII

The activities of the ***"Improvement of Navigation on the San Juan de Nicaragua River"*** Project may cause potentially significant environmental impacts. According, in the framework of Decree 45-94, Regulations for Environmental Permits and Environmental Impact Assessments, Article 5, part j, it is mandatory to have an Environmental Permit prior to the project's execution, which requires the performance of an Environmental Impact Assessment by the ***Empresa Portuaria Nacional (EPN)*** company.

VIII

The procedures prescribed in the currently applicable legal framework have been fulfilled in the procedure carried out in response to the application for an Environmental Permit, and the interinstitutional technical team has determined that the project is environmentally viable, *provided the proponent strictly complies in its entirety* with all the environmental measures and actions stipulated in the Environmental Impact Assessment, its corresponding Environmental Management Program, and the Addendum, which include all the preventive and mitigating actions prescribed for handling of the material extracted from the river bed and its disposal at the final dumping sites identified in the environmental impact assessment, as well as the final disposition of the domestic effluents and handling of the project's solid wastes.

NOW, THEREFORE

The Ministry of the Environment and Natural Resources, Directorate General of Environmental Quality, acting in the use of the powers conferred on it by the Regulations of Law 290, Executive Branch Organization, Competence, and Procedures Act, Decree 25-2006, Article 294, Law 217, Article 27 of the General Environment and Natural Resources Act, and Articles 28 and 29 of Decree 45-94, Regulations on Environmental Permits and Environmental Impact Assessments, as well as on the basis of the technical criteria and considerations adopted by the interinstitutional technical team which issued the determination on the Environmental Impact Assessment.

RESOLVES

First: To grant an **Environmental Permit** to the **Empresa Portuaria Nacional (EPN)** company for execution of the ***"Improvement of Navigation on the San Juan River of Nicaragua."***

Second: For the intents and purposes of this environmental permit, the Empresa Portuaria Nacional (EPN) company shall henceforth be referred to as the Proponent.

Third: Based on the criteria and recommendations of the inter-institutional technical team which evaluated the Environmental Impact Assessment, and in compliance with the legal and environmental provisions currently in force, the Directorate General of Environmental Quality of the MARENA adopts the following provisions, which are mandatory and require strict compliance:

1) This Environmental Permit is issued exclusively for improvement of the navigation route which permits the communities in the southeastern corner of the national territory to be in contact by river with the rest of the country. The navigation channel shall have the following dimensions: in its cross-section it shall be 20 meters wide at the bottom, 30 meters wide at the surface, and with a minimum depth of 2 meters in the dry season, throughout a section 41,963.57 meters in length which runs from the site known as Punta Chingo Petaca to the Estuary of the San Juan River, plus the construction of an access canal to carry the equipment required for the clean-up operation from the Caribbean Sea to the Estuary of the San Juan de

Nicaragua River, which shall have a cross-section 40 meters wide at the bottom, 60 meters wide at the surface, and with a minimum depth of 6 meters, along a total length of 2,000 meters.

2) The material extracted from the river bed, calculated at **(1,693,787 m_3)** shall be deposited at the sites previously identified in the Environmental Impact Assessment, located on the left bank of the San Juan River along the length of the section where the project's activities will be conducted. In consideration of the conditions in the area and the project's importance at the national level, the MARENA accepts the use of the sites proposed in the Environmental Impact Assessment as the only alternative for dumping of the extracted material. The authorized sites, by UTM coordinates, are as follows:

N°	NAMES OF THE DEPOSIT SITES	UTM COORDINATES		AREA (MZ)	VOLUME m^3
		NORTH	EAST		
0	Public property*	1 211 244	202 220	00	
1	Public property	1 909 201	206 250	2.25	60,704
2	Public property	1 207 483	207 205	00	98,273
3	Public property	1 207 319	207 736	2.08	14,579
4	Juan Popa	1 206 540	207 309	15.73	110,532
5	Public property	1 205 357	207 314	5.61	39,404
6	Chepe huevo	1 204 649	208 162	1.19	16,744
7	Daniel Reyes	1 203 662	208 278	13.39	188,184
8	Noel Castillano	1 202 463	207 727	2.13	29,958
9	Calixto	1 200 692	207 477	14.65	102,941
10	José Gómez	1 199 981	207 762	4.73	66,436
11	José Gómez	1 198 453	208 250	27.41	192,571
12	Alejandro Reyes Aragón	1 197 832	208 809	19.22	135,019
13	Socorro López S.	1 196 615	208 689	9.01	63,283
14	Darío Sánchez (El Jobo)	1 194 306	205 891	2.40	33,700
14-A	Isla Salomón	1 193 874	205 266	2.12	21,226
14-B	Isla Salomón	1 194 151	204 172	2.12	21,226
15	Ricardo Salinas	1 194 453	203 651	1.86	26,090
16	Silvio Reyes	1 193 900	202 322	25.16	
17	Rubén Reyes	1 193 247	200 549	13.73	363,801
18	Felipe Espinoza	1 193 136	199 890	5.34	75,074
19	Gregorio Chamorro	1 192 607	198 443	0.52	7,334
20	San Juan River Delta	1 192 386	197 532	1.19	2,050
21	Public property	1 192 429	197 088	1.30	---
22	Public property	1 192 535	196 203	0.39	5,544
23	Public property	1 191 939	194 134	1.20	16,874
24	Public property	1 189 857	189 947	6.65	46,742

3) It is necessary to protect and preserve the riverbank vegetation at all the sites used as dumps for extracted materials. At the sites where there is no riverbank vegetation or where this type of vegetation may be adversely affected by the activities to be conducted, the project's executor is obligated to restore it in accordance with a reforestation plan, making use of native species. No exotic species may be introduced for recovery of the vegetable cover in the ecosystem affected by the project's activities. The protective barriers on the left bank of the San Juan River must include the construction of a structure that does not permit erosion or overflowing of the banks when the river rises; the structures must be built prior to or concurrently with the process of extraction of the sediment material from the river bed, according to the constructive specifications shown in the environmental impact assessment.
4) Thirty (30) days before commencing activities in the project, the Proponent must mark all the sites that have been identified as material dumps in order to facilitate their localization, identification, and management. Pennants, stakes, or other kinds of marking devices which are easily identifiable from a distance may be used for this purpose. The number or name given to the dump site, the area to be used, and the volume of material to be dumped must appear on the markers.
5) Before material begins to be dumped in the spaces selected as dumping sites, each of said sites must first be cleared of all vegetation and the barriers, which will ensure the material's confinement, must be built, to avoid the material's return to the river bed. Material may not be dumped on existing vegetation at the dump site. At no time may material be dumped at a distance of less than 50 meters from the river bank, except at those sites whose characteristics so permit, but this must be compensated for with theconservation works to be built.
6) The wood resulting from the removal of vegetation at each of the dumping sites must be offered to the nearby inhabitants for their use, for either energy or lumbering purposes. The remains of plants which cannot be utilized shall be used in environmental recoverywork in the affected spaced. These vegetable remains may not be buried under the extracted material. The MARENA prohibits the burning of any residues of cut vegetation.
The Proponent must make a record of the origin and volume of the vegetation removed (wood to be utilized), as well as a classification and the subsequent uses made thereof.
7) Tree remnants which are extracted from the river bed, such as trunks and branches, must be used in the construction of barriers to confine the dumped dredged material or to stabilize the river banks.
8) The Proponent must make certain that the fuel required for the dredging is supplied by personnel trained for said operation, to prevent leaks or spills of substances of this kind into the San Juan River.
9) The Proponent must ensure the permanent existence of floating barriers and absorbent material in the vessel to be used for the cleaning process in the river, so as to respond to, and quickly contain, any quantity of hydrocarbons which might be generated by an accidental leak or spill of substances of this kind, and to immediately extract from the water any hydrocarbon residues that might be recovered, so as to prevent the propagation of pollution in the event of an emergency.
10) The equipment and machinery to be used to clean the river must carry the containers and recipients required to store the residues generated in the maintenance work on its motors and equipment. Residues must be handled as prescribed in the international maritime navigation agreements. The MARENA does not permit residues of this kind to be abandoned at any of the river ports on the San Juan River.
11) The Proponent must provide for environmental supervision of the project throughout its period of execution, and to that end it must retain the services of a professional who has the necessary qualifications and experience, who shall perform the function of permanent environmental manager in the area and in all project activities. The Proponent must inform

the MARENA of the retained professional's name prior to the project's execution; he shall receive instructions on the environmental aspects to be supervised and the reports which must be submitted pursuant to this Resolution's provisions, to ensure environmental compliance and control in view of the area's characteristics. The MARENA Delegation at Río San Juan shall delegate an environmental inspector, who shall provide ongoing monitoring throughout the performance of the activities, and his expenses shall be borne by the project's Proponent.

12) The Proponent must ensure that the company and/or personnel hired to perform the river clean-up work respect and protect the local flora and fauna, as well as the rest of the environmental factors present in the area where the project's activities are conducted. The MARENA prohibits hunting, capture, and utilization of all kinds of fauna and flora species present in the area, in accordance with the provisions of the currently applicable legislation and the San Juan River of Nicaragua Wildlife Refuge Management Plan.

13) The inhabitants who live in places close to the dumping sites for dredged material must be informed of the commencement of operations near their homes at least thirty (30) business days in advance. The Proponent must guarantee the restrictions on movement at the site where the dredged material will be dumped, as well as the necessary security.

14) In the event work is done at night, and at the sites where the machinery and equipment must remain during the night, it is necessary to ensure lighted signs of the area, to prevent accidents to persons and public and private vessels.

15) The material extracted from the riverbed must be dumped at the selected sites in laminar form over a relatively flat surface no more than 1.1 meters higher than the maximum altitude of the land. All the material must be confined in order to prevent its return to the riverbed, as prescribed in the Environmental Impact Assessment.

16) Dumping of material generated by the clean-up on the river bank and nearby areas between the outlet of Caño Sucio and Boca de San Juanillo is to be avoided, so as to prevent alterations in the circulation of waters in view of the very gentle slope in that natural drainage area for the Ebo, La Barca, and Sillico lagoons, in consideration of the importance of the area's primary production and to support the potential of its fishing resources, with special protection for the swamp and mangrove habitats in the area of the San Juan River's mouth, which forms the tideland facing the sea, in accordance with the fishing biology study's findings.

17) When the dumping of material extracted from the river bed is completed at each dump, it is necessary to immediately ensure the conditions for the natural regeneration, reforestation, and restoration of the vegetation at the affected site. The Proponent must coordinate with the MARENA Delegation at Río San Juan and the San Juan de Nicaragua Municipal Government in regard to the measures taken for the protection and vigilance of these spaces, so as to prevent their being used for the construction of houses.

18) The MARENA may authorize the dumping of extracted material at places where the population needs it, and especially the populating living in hamlets along the bank of the San Juan de Nicaragua River, provided the technical assessment so permits, with the aim of elevating the land and reducing the risk of flooding of said inhabited areas. The measures for protection of the population must be coordinated between the Proponent, the Municipal Government of San Juan de Nicaragua, and the local village leaders.

19) Since the use of the material extracted from the San Juan River in useful works for the population is a good environmental practice, the MARENA recommends coordination of efforts and resources between the Proponent and the government agency responsible for the construction of the San Juan de Nicaragua airstrip, for the formation of a material bank to be used in the construction of said airstrip, houses, streets, and sidewalks in the municipality, with a view to reducing the volumes of material to be dumped in the most vulnerable areas of wetlands.

20) The Proponent must allocate the human, technical, economic, and material resources needed to fulfill its undertakings for protection of the environment and the natural resources of the area, arising from this Administrative Resolution and the provisions of the Environmental Management Program, a copy of which is attached to this Environmental Permit.
21) Any accident or event which occurs and threatens to adversely affect the environment and natural resources in the area, even when it has been brought under control, must be immediately reported by the Proponent to the representatives of the following authorities, in verbal form (first notification) and in writing, with the details of the incident and the actions taken to control it:
• The MARENA Departmental Delegation at Río San Juan.
• The Office of the Executive Secretary of the Southeast Nicaragua Biosphere Reserve.
• The Directorate General of Environmental Quality at the MARENA Central Headquarters.
• The Directorate General of Natural Patrimony at the MARENA Central Headquarters.
• The Municipal Government of San Juan de Nicaragua.
• The Directorate General of Water Transport in the MTI.
22) The MARENA prohibits the construction of any temporary or permanent buildings on "dry land up to **30 meters** behind the line of maximum marks or that of the permanent course of rivers and lakes ...," pursuant to Article 72 of Law 217, General Environment and Natural Resources Act.
23) The MARENA Central Headquarters or the MARENA Territorial Delegation at Río San Juan shall inspect the area of the project when they see fit, with or without prior notice.
24) In the event of any noncompliance or the violation of any of the foregoing clauses, the Proponent shall incur warnings, fines, temporary suspension, or cancellation of theEnvironmental Permit, as prescribed in the environmental legislation in force in the country.
25) The holder of the Environmental Permit undertakes to comply with the financial security prescribed in **Article 33 of Law 647, Reform of and Additions to Law No. 217, General Environment and Natural Resources Act**, once it has been defined by the Ministry of the Environment and Natural Resources and published in The Gazette- Official Journal.
The Environmental Permit granted hereby is valid only for the activities specified in the information sent to the Ministry of the Environment and Natural Resources. If the Proponent intends to introduce any broadening or modification of the approved project, it must first apply to the MARENA for the appropriate permit.
This resolution determines that the project's execution is environmentally feasible, subject to compliance with the conditions prescribed therein, but it does not relieve the project's legal representative or owner of the obligation to comply with the other permits required by the laws in force in the country, *nor does it substitute for any other requirement which might be prescribed by other authorities.*
This permit shall enter into force as of the date of delivery to the Proponent, a record of which must be left, and if the project is not executed in the next 18 months, it must be renewed, for which the MARENA shall evaluate the conditions prevailing at the date thereof, being empowered to authorize its renewal provided no changes or variations of the original environmental parameters in the area of the project have occurred.
Done in the city of Managua on the twenty second day of December, 2008.

[SIGNED]
Hilda Espinoza Urbina
Director General
Directorate General of Environmental Quality

Annex 161

Ministry of Environment and Natural Resources of Nicaragua (MARENA)
DGCA Resolution

Ref. 038-2008-A1

30 October 2009

ANNEX 10

DGCA RESOLUTION No. 038-2008 – A1

Following examination of the application filed by Mr. Virgilio Silva, acting in his capacity as Legal Representative of the Empresa Portuaria Nacional (EPN) company, for a broadening of the Environmental Permit for the ***"Improvement of Navigation on the San Juan de Nicaragua River,"*** approved under Administrative Resolution **No. 038-2008** of the twenty eighth day of August, two thousand nine, Registration No. 037-2006.

Following the review of the information in support of the change in the project's components, and specifically, part **1 of the environmental permit**, which is reproduced verbatim as follows:

"This Environmental Permit is issued exclusively for improvement of the navigation route which permits the communities in the southeastern corner of the national territory to be in contact by river with the rest of the country. The navigation channel shall have the following dimensions: in its cross-section it shall be 20 meters wide at the bottom, 30 meters wide at the surface, and with a minimum depth of 2 meters in the dry season, throughout a section 41,963.57 meters in length which runs from the site known as Punta Chingo Petaca to the Estuary of the San Juan River, plus the construction of an access canal to carry the equipment required for the clean-up operation from the Caribbean Sea to the Estuary of the San Juan de Nicaragua River, which shall have a cross-section 40 meters wide at the bottom, 60 meters wide at the surface, and with a minimum depth of 6 meters, along a total length of 2,000 meters."

WHEREAS

I

The Environmental Permit under Administrative Resolution **038-2008**, for the **"Improvement of Navigation on the San Juan de Nicaragua River"** project stipulates that the Proponent must submit a timely application to the Directorate General of Environmental Quality of MARENA for the review and approval of any proposed modification of the project.

II

Law 217, General Environment and Natural Resources Act, as amended, provides in Article 27 that: "Projects, works, industries, or any other activity, whether public or private, by national or foreign investment, during their pre-investment, execution, expansion, rehabilitation, or conversion stages, which in view of their characteristics may provoke any deterioration of the environment or natural resources in accordance with the specified list of categories of works or projects established in the respective Regulations must obtain an Environmental Permit prior to their execution."

III

According to the information submitted by the Proponent, the changes consist of cleaning a stream which connects the San Juan River with the Harbor Head Laguna in Nicaraguan territory, using manual equipment. The clean-up work shall be performed along a length of 1,560 linear meters with a maximum of 30 meters in width, with the starting point at reference coordinates North 1208638 and East 863133, and the end point at coordinates North 1209823 and East 863450. The clean-up work will be performed with a dredge on a section that has become sedimented, located at reference coordinates North 1208439 – East 863131, and (final) coordinates North 1208134 – East 863136 and North 1208138 – East 963196, with a width of 59 meters by 300 meters in length and 6 meters in depth. A total of 37,500 m_3 of sediment will be removed in this activity, to facilitate navigation in these sections of the river. Following performance of the technical inspection in the area in which the project's field activities will be conducted, in coordination with the project's representatives.

THEREFORE:

The Ministry of the Environment and Natural Resources, acting through the Directorate General of Environmental Quality and in the use of the powers conferred by **Law 290, Executive Branch Organization, Competence, and Procedures Act, Article 28, part b, Regulations of Law 290, Decree 25-2006, Article 294, Law 217, General Environment and Natural Resources Act, Articles 27, 28, 29, and all the foregoing technical considerations.**

RESOLVES

First: To modify the Environmental Permit for the **"Improvement of Navigation in the San Juan River of Nicaragua"** project, which has been requested by the Empresa Portuaria Nacional company.

Second: Administrative Resolution **No. 038-2008** is modified in regard to the components of the third resolution, number 1, relating to the project's location and components, so as henceforth to read as follows:

Part 1) This Environmental Permit is issued exclusively for the rehabilitation of the navigation route which improves contact by river between the communities in the southeastern corner of the national territory and the rest of the country. The navigation channel shall have the following dimensions: in its cross-section it shall be 20 meters wide at the bottom, 30 meters wide at the surface, and with a minimum depth of 2 meters in the dry season, throughout a section 41,963.57 meters in length which runs from the site known as Punta Chingo Petaca to the Estuary of the San Juan River. In addition, the company shall perform clean-up activities on a caño which connects the San Juan River with the Harbor Head Lagoon, in Nicaraguan territory The clean-up work shall be performed along a length of 1,560 linear meters with a maximum of 30 meters in width, with the starting point at reference coordinates North 1208638 and East 863133, and the end point at coordinates North 1209823 and East 863450. The clean-up work will be performed with a dredge on a section that has increased in sediment, located at reference coordinates North 1208439 – East 863131, and (final) coordinates North 1208134 – East 863136 and North 1208138 – East 963196, with a width of 59 meters by 300 meters in length and 6 meters in depth. A total of 37,500 m_3 of sediment will be removed in this activity, to facilitate navigation in these sections of the river.

Third: The following modal charges are added to the third resolution element of this environmental permit, under Administrative Resolution No. 038-2008:

26. The sediment dump sites must be identified and delimitated, chiefly making use of areas cleared of vegetation to reduce the impact on the flora and fauna typical of the ecosystem in question.

27. The sediments extracted as a consequence of the activities performed by the dredging equipment may not be deployed within a minimum distance of 50 meters in length from the river bank, to avoid erosion and run-off of the sediments in question back to the river channel.

28. Tree trunks or sections are to be used as barriers in the sediment dump areas.

29. All works must be supervised by EPN and have environmental monitoring by MARENA specialists and the environment regent delegated by the EPN.

30. The clean-up work for maintenance of the stream must be done for the most part with manual equipment such as (picks and shovels).

31. Ecological (mobile) latrines must be installed for use by the personnel working in the project.

32. The equipment must be insured, and safety precautions must be taken to prevent accidents among the workers, chiefly in the form of snake bites.
33. The requirements of the contingency program established in Resolution 038-2008 must be fulfilled for the movement and storage of hydrocarbons used in the project's activities in this stage.
34. During the performance of the activities, all domestic wastes must at all times be collected and disposed of outside the area, in accordance with the technical environmental rules for handling of non-hazardous wastes.
35. If it is not possible to avoid clearing vegetation, the affected vegetation must be replaced and compensated for in the amount of 10 trees for every tree cut down, with species native to the area. Natural regeneration of species must also be promoted.
Fourth: All the remaining provisions of **Administrative Resolution No. 038-2008** remain in force.
Done in the city of Managua on the 30th day of October, two thousand nine.

[SIGNED]
Hilda Espinoza Urbina
Director General
Directorate General of Environmental Quality
[seal]

Annex 162

Ministry of Environment and Natural Resources of Nicaragua (MARENA)
"Technical Opinion Environmental Impact Study Project: Improvement of Navigation on the San Juan River de Nicaragua River"

28 November 2008

ANNEX 7

MINISTRY OF THE ENVIRONMENT AND NATURAL RESOURCES
MARENA
General Department of Environmental Control
TECHNICAL OPINION
ENVIRONMENTAL IMPACT STUDY PROJECT:
IMPROVEMENT OF NAVIGATION ON THE SAN JUAN DE NICARAGUA RIVER

1. Name of the Project: Improvement of Navigation on the San Juan de Nicaragua River.
2. Proponent: Empresa Portuaria Nacional [National Port Company] (EPN).
3. Location of project: San Juan River, from the point known as Punta Petaca to its mouth in the Caribbean Sea, covering a total of 42 kilometers. Department of Rio San Juan:

Site Coordinates	
North	East
1189857	189947
1210770	204124

4. Brief Description of the project and its alternatives:

The project consists in the cleaning and maintenance of the navigation channel along a section of 41,963.57 linear meters that extends from the site known as Punta Chingo Petaca to the mouth of the San Juan River. The project is located in the jurisdiction of the municipality of San Juan de Nicaragua, Department of Rio San Juan, within the limits of the Rio San Juan Wildlife Refuge, in the agroforestry usage area.
A cutter and suction dredge will be used to dredge the riverbed.
For the effects of the environmental impact study the area of direct and indirect influence for the project has been calculated at 100 meters wide x 42,000 meters long, equivalent to 420 (hectares).
The area of direct influence affected through the depositing of cleaning material has been calculated at 130.8 (hectares), this being the sum of the areas (m2) of the 23 sites selected for depositing, plus the right of way or easement for the sediment discharge piping (0.069 hectares).
The area directly affected by the restoration of the Rio San Juan navigation channel has been calculated at 126 hectares (30 meters wide x 42,000 meters long).
The material extracted will be deposited in small deposits distributed along the northern bank along the section of the river to be cleaned. A total of some 23 potential sites have been identified to be used as deposits of dredged material as well as an additional alternative site if necessary, No. 0, which are detailed below.

List of Authorized Sites by UTM Coordinates

Table No. 1

Nº	NAMES OF THE DEPOSIT SITES	UTM COORDINATES		AREA (MZ)	VOLUME m^3
		NORTH	EAST		
0	Public property*	1 211 244	202 220	00	
1	Public property	1 909 201	206 250	2.25	60,704
2	Public property	1 207 483	207 205	00	98,273
3	Public property	1 207 319	207 736	2.08	14,579
4	Juan Popa	1 206 540	207 309	15.73	110,532
5	Public property	1 205 357	207 314	5.61	39,404
6	Chepe huevo	1 204 649	208 162	1.19	16,744
7	Daniel Reyes	1 203 662	208 278	13.39	188,184
8	Noel Castillano	1 202 463	207 727	2.13	29,958
9	Calixto	1 200 692	207 477	14.65	102,941
10	José Gómez	1 199 981	207 762	4.73	66,436
11	José Gómez	1 198 453	208 250	27.41	192,571
12	Alejandro Reyes Aragón	1 197 832	208 809	19.22	135,019
13	Socorro López S.	1 196 615	208 689	9.01	63,283
14	Darío Sánchez (El Jobo)	1 194 306	205 891	2.40	33,700
14-A	Isla Salomón	1 193 874	205 266	2.12	21,226
14-B	Isla Salomón	1 194 151	204 172	2.12	21,226
15	Ricardo Salinas	1 194 453	203 651	1.86	26,090
16	Silvio Reyes	1 193 900	202 322	25.16	
17	Rubén Reyes	1 193 247	200 549	13.73	363,801
18	Felipe Espinoza	1 193 136	199 890	5.34	75,074
19	Gregorio Chamorro	1 192 607	198 443	0.52	7,334
20	San Juan River Delta	1 192 386	197 532	1.19	2,050
21	Public property	1 192 429	197 088	1.30	---
22	Public property	1 192 535	196 203	0.39	5,544
23	Public property	1 191 939	194 134	1.20	16,874
24	Public property	1 189 857	189 947	6.65	46,742

*The deposit identified with the number "Zero" is alternate and it has been selected because of its evident environmental benefits; however, a technical and economic evaluation is required to determine its use. Total volume (1,693,787 mts^3).

The physical characterization of the sites identified for deposits of materials coming from the cleaning of the river indicates that they are located in the agroforestry area, in accordance the Rio San Juan Wildlife Refuge Management Plan. They are areas that are affected by human activities (agricultural and livestock systems), low-density and dispersed humanized areas, with a small amount of vegetation in the riverbank area between site No. 24 and No. 15. The area with the greatest amount of vegetation is between Site No. 15 and the mouth of the San Juanillo rivers; the rest are wetlands (zacate gamalote and yolillo palms), among other species inherent to that ecosystem.

5. Environmental Impacts Identified and their mitigation measures Environmental impacts on the quality of the water due to the removal of sediment from the bottom of the section to be cleaned. (Parameters)

• Reduction in dissolved oxygen
• Reduction in the transparency of the water
• Change in the color of the water
• Increase in turbidity due to suspended sediment
• Changes in the pH values
• Changes in the hardness of the water
• Change in electrical conductivity of the water
• Change in the Biochemical Demand for Oxygen (BDO)
• Changes in the temperature stratification of the water column.

Environmental impacts on Vegetation and Landscape

• Effect on the landscape through elimination of vegetation because of disposal of material from the cleaning.
• Effect on the forest (principal species found in the identified sites: *Yolillo*, trumpetwood, *chilamate*, *jocote*, *jobo*, plantain, *zacate gamalote*, royal palm, heliotropes, banana plants, coconut palms, *pejibaye*, grass and trees such as sparrowhawks, silk-cotton tree, cedarwood, *chilamates*, *sotocaballo*, *guaba*, *yema de juevo*, *camíbar*, *sangre grado*, balsa, *guácimo*, *zacate* for cattle, weeds, bamboo, among other species of bushes inherent to the region.

Environmental Impacts on Aquatic and Terrestrial Fauna

• Impact on the fauna because of emigration to other areas faced with the loss of their ecological niche and because of the elimination of vegetation.
• Effect on the benthonic communities **due to removal of sediments**
• Effect on fish habitats
• Effect on mammal populations
• Effect on species of fauna because of an increase in noise during the operations.

Environmental Impacts on Ecological Processes

• Changes in the diversity of species
• Changes in the abundance of the populations
• Effect on the wildlife refuge area.

Evaluation of the environmental impacts on the water quality

1. Benthonic and planktonic organisms will be affected because of the removal of sediments, the former because they are on the riverbed, and the latter because of an increase in the turbidity of the water, **however**:

• Little density of species of these organisms was found in the San Juan river and the section to be cleaned.
• The bottom sediments are not a substrate suitable for the settlement of species there and moreover because the makeup of nutrients is low, the greatest makeup of nutrients by instantaneous load into the San Juan River was transported by the tributary rivers Boca de Sábalos, Santa Cruz, and Melchora. This entry of nutrients will be beneficial to the dredged section because the low diversity of species is attributed to the lack of food for primary and secondary organisms in the food chain.
• The fine particles will settle on the bottom and start colonization by benthonic organisms and their consequent effect on the food chain.

2. **The impacts are considered low intensity and inevitable**, they are located along the length of the channel, their permanence over time is fleeting, and their effect is indirect.
The recovery of the physiochemical parameters of the water (transparency, color, turbidity) depend on the amount of dissolved solids in the water, and it is going to depend on the time the operations last, which are considered immaterial due to the size of the grains (sand), because the Granulometry study shows that:

• The material does not have a significant presence of fine materials that might remain suspended in the water while operations subsist.

• Only the section next to Punta Petaca had clayey-silty material that could increase the solids suspended in water; however, the suspension of this fine material will be beneficial for the settlement of benthonic communities, once they settle.

3. The study shows a percentage of oxygen saturation (OD) of 90% in the San Juan delta, therefore the entry of water with a high concentration of OD, toward the dredging area, will be beneficial for the development of organisms.

4. The ionic content in the San Juan River is within the limits allowed for human consumption; however, there are periods when sulfates exceed these limits. **The concentration at which sulfates appear will depend on the time when the operations are performed**; they may be altered principally during the start of the rainy season, therefore the impact on the quality of the water in terms of ionic content **is not significant**. Moreover the iron content found along the San Juan River and in the section to be cleaned exceeds water quality standards, and therefore the makeup of this action from the San Juan River, will not negatively affect the project activities.

5. The addition of pesticides in the water of the San Juan River to the dredging area from the main current will be increased because of the removal of sediment if it is done in the peak of the rainy season (June) when the highest concentrations of pesticides are reported. It would fall in the dry season; however, the concentration of pesticides in the sediments tends to increase.

6. The pH of the water is affected because this physical parameter is a function of the dissolved CO_2, and it is intimately related to photosynthesis and respiration. Both parameters will be affected by the action of cleaning the river (by the suspended particulate matter).

7. The changes in the hardness of the water is due to the release of some compounds that are in the sediment that will be released by the cutting and suction action, as well as because of the effect of depositing the material (sediments) on the soil.

Environmental Measures

• Avoid the use of areas near the mouth of the San Juan and Sanjuanillo River for the depositing of materials, considered a critical and vulnerable area.

Mitigation Measures to prevent impacts on fish

• Areas near the mouth of the San Juan and San Juanillo rivers will not be used for depositing materials, due to the confluence of the Sea and River, the areas of the mouth of the San Juan River are responsible for the regeneration of the local biota and a large number of organisms that form part of the food chain.

• Maintain strict control over the handling of hydrocarbons to avoid spills.

Environmental measures to prevent and mitigate the impacts on the landscape, the fauna, and the soil

• The deposits of materials resulting from cleaning the river will be located in the identified, described, and geo-referenced sites established in the environmental authorization issued by MARENA.

• In a 9-month period a plant restoration program will be implemented in the deposit areas with species of trees and bushes inherent to the humid tropics that characterize this project zone and the plant life inherent to the area will be recovered by natural regeneration.

Environmental Measures to prevent fuel spills on water and soil resources

• Waste from lubricants derived from maintaining the equipment and machinery must be collected in hermetic containers for their subsequent elimination outside the refuge area.

• Compliance with international regulations regarding the shipping, handling of hydrocarbons and oily waste, which must be established under the terms of the contract with the company responsible for the cleaning activity.

• The storage and handling of hydrocarbons in the dredger and auxiliary equipment must be performed by duly trained personnel, in order to prevent ignorance on the method of handling the fuel.

• The contingency plan will be implemented in case of an accidental spill of hydrocarbons; the proponent must have onsite all of the equipment and materials (absorbent barriers) to stop and control any fuel spill that might occur.

Environmental Measures (noise and air quality contamination)

• Workers will be provided with job protection equipment to prevent effects on their health from contaminating gases derived from the combustion of the equipment used in cleaning the San Juan River.

The impacts that the San Juan River cleaning project will produce on the socioeconomic aspects are positive in nature.

• The quality of life of the population is improved by resolving the navigation problem, which blocks complete inclusion of the entire municipality of San Juan de Nicaragua into the dynamic of national life.

• Increase in the number of tourists who go to the San Juan River area.

• Savings in the costs of transport due to a reduction in transport time.

• Increase in the Flow of Transport

• Shipping of cargo

• Improvement in local fishing by increasing the fish population and as a result of the better living standard of the inhabitants

• Increase in the Source of temporary employment

• Changes in the Local Economy

• Changes in the Regional Economy.

Environment Measures due to Socioeconomic Impacts

• The residents who reside on the outskirts of the material deposit sites will be informed at least thirty (30) business days in advance, on the start of operations near their dwellings.

• Project staff and the people near the deposit sites will be trained regarding safety measures and restrictions on movement to the site where the deposit work on the extracted material will be performed.

6. Other environmental management measures proposed in the EIA:

6.1 Environmental Supervision and monitoring plan

The objective of environmental supervision is to guarantee the performance of the project without causing damage to the environment and to its users. It also has the following objectives:

Through follow-up, they seek to be able to perform an *ex post* evaluation, once a reasonable period of time has elapsed, to see to what degree the forecasts are met and if it is necessary to adopt new corrective measures.

The supervision includes 7 main activities, which are:

1. Cutting and suction of the material

• Evaluate physiochemical parameters in the water. Samples must be taken twice a day.

• Evaluate the quality of the sediment, which they suggest must be performed on the dredger itself.

• Supervise compliance with workplace safety and hygiene regulations.

2. Transfer of the material = sediment
• Install visible lighted signs to prevent accidents.
3. Depositing of material = sediment
• Evaluate physiochemical parameters in the liquid content of the dredged material (this is the same as point 1).
• Evaluation of the granulometry of the sediment to be dredged.
• Determine and evaluate the surface flow of the deposit (the site must be outside the areas affected by currents to avoid water erosion).
4. Storage and supply of hydrocarbons
• Evaluate maintenance operations on the dredge's engines.
• Supervise the supply operations and do not allow fuel to be spilled on deck or on the river's water.
5. Evaluate the signage and signaling implements. In the work area visible signs should be posted on banderoles at the beginning, middle and end. At night lighted signs should operate to prevent accidents.
6. Evaluate the plant material that is going to be used. The seedlings to be used in the replanting program must have a height of 0.50 meters or more, and be healthy.
7. Evaluate the implementation of the plant restoration, reforestation, and natural regeneration program.

7. Summary of opinions received and the respective comments:

The public consultation on the project was held from August 9 to 15, 2006, by making the Environmental Impact Document available at City Hall in San Juan de Nicaragua, City Hall in El Castillo, MARENA-Rio San Juan Office located at the departmental offices of San Carlos and in the MARENA – Central Documentation Center, and the following results were obtained: Comment of Mr. Mario Mallorquín and Ronald Estrada, from San Carlos: We wonder, what will happen with the tributaries of the San Juan River that come from the reservoir?

Why is there no replanting to be done over the (dredged) material to prevent erosion?

How will the sediments be handled in the wetlands areas?

He indicates that mangroves do not prosper under these conditions and he suggests reviewing the plants to be replanted well, and they recommend native species?

They note inconsistencies in the EIA report because activities in Bluefields Bay are mentioned but not in the San Juan River, which should be corrected.

On landfills with dredged material he requests clarification on whether the material is going to be placed in hollow spaces or in the creek. He states his concern in relation to the change of speed of the river current which could be caused by the dredging and wonders how traditional fishing will be affected, in particular royal shad and sea bass?

Messrs. Mallorquín and Estrada are correct in the sense that native species must be required for the reforestation effort, which must also be used in the mounds of dredged material to reduce the erosive processes. In terms of the depositing of sediments in the wetlands area, the work group will evaluate the arguments presented by the consultants who prepared the EIA to make use of those areas. According to the EIA the deposit sites for the dredged materials are all located on dry land and the members of the workgroup will require that the soil layer be removed in each deposit and used for plant coverage recovery activities.

Mr. Antonio Ruiz Meléndez and Davis Morales: They claim that no reference is made to the existing population in the area who live on the shore of the river. They think that the waste and trash of the people who will participate in the work was hidden, the same as with the transfer of lubricant waste. The high rainfall levels of the area and the risks of natural phenomena are not discussed, and therefore there are no mitigation measures for emergency situations.

The cause / effect matrix does not have the terminology of the nomenclature used in that matrix.
They claim that one area is reflected in the description and the environmental management plan reflects another. The DIA does not take into account the summer season for a full evaluation of the parameters. In relation to the DBO in one part, it indicates that 1,000 meters is going to be taken, and in the other 500 meters.
He notes that the bathymetry is missing, the type of dredger to be used, the useful life of the dredging, and no mention is made of international commitments like the RAMSAR convention.

8. Conclusions

• After the Delta the flow volume that goes through the San Juan River falls considerably, because a large part of that flow volume is discharged into the Caribbean Sea through the Colorado River.
• The flow obstruction conditions that exist in the channel bed of the San Juan River in the last 40 kilometers of its trajectory have affected several species of aquatic fauna, because a lot of those species penetrated through the river to complete their biological cycle upstream from the River.
• The San Juan River is the only travel route that the people of the municipality of San Juan de Nicaragua and the people who live on the banks of the river, both on the Nicaraguan side and the Costa Rican bank, currently have. The conditions of the channel bed make transportation in that part of the country more expensive.
• In the sites where the riverside forest has been eliminated, the banks of the river are subject to a significant process of water erosion which sometimes drags a large amount of the soil that is deposited in the river's channel.
• The workgroup believes that the dredging to improve navigation along the San Juan River is a necessity, and the execution of this project must be exploited to correct a series of problems that are being caused along the banks of the river that are affecting the biodiversity and the water. It is important to recover the riverbank plant coverage to protect the channel bed of the river, the biodiversity, and the water source itself.
• The inter-institutional technical team that evaluated the EIA believes the project is environmentally feasible if EPN complies strictly with the environmental measures established in that study and the provision issued by MARENA under an administrative resolution can prevent, mitigate, and offset the possible negative impacts.

8. Recommendations on the most important aspects for decision-making

a) Maintain constant and fluid communications between the National Port Authority and the bodies responsible for monitoring the environmental performance of the activity.
b) The EPN must document all of the environmental management activities, by sending to DGCA/MARENA, the MARENA-Rio San Juan office, the Environmental Unit of the Municipal Government of San Juan de Nicaragua, and the DGTAN-MTI, all of the documentation related to environmental performance at the site where the project will be performed.
c) Qualified personnel must be hired to meet the commitments acquired by the project's proponent, as per the Environmental Impact Study presented.
d) All events that affect or threaten to affect the environment must be reported to the competent authorities immediately, such as MARENA, the municipal government of San Juan de Nicaragua, or the MARENA-Rio San Juan territorial office.
e) The company must ensure the technical and financial resources needed to undertake the Environmental Management Program suggested in the EIA.

Names of the members of the Workgroup Signature
Mr. Milton Medina Calero, DGCA/MARENA [signature]
Ms. Elsa Vivas, DGCA-MARENA [signature]
Mr. José Luis Galeano, MARENA-Rio San Juan Office [signature]
Ms. Liliana Diaz, DGAP – MARENA [signature]
Mr. Luis Garcia, DGTAN-MTI [signature]
Mr. Sergio Cordonero, INETER [signature]
Mr. José Tomas Valle, INETER [signature]
Managua, November 28, 2008

Annex 163

Ministry of Environment and Natural Resources of Nicaragua (MARENA) Technical Monitoring Report on the Project "Improvement of the Navigability of the San River".

24- 26 November 2010

ANNEX 11
TECHNICAL MONITORING REPORT
PROJECT "IMPROVEMENT OF THE NAVIGABILITY OF THE SAN JUAN RIVER"
From the 24th to 26th of November 2010

[Photo]

Participants:
Omar Brenes, MARENA Delegate – San Juan River
Elsa Vivas Soto, Environmental Specialist – DGCA/MARENA
Diana Castillo Herrera, Environmental Specialist – EPN
Mr. Luis Felipe Marín, Dredging Captain – EPN
Mr. Jorge Agustín Soza, Technical Assistant – EPN

Introduction:
The Project **"IMPROVEMENT OF NAVIGATION IN THE SAN JUAN RIVER OF NICARAGUA** consists entirely of the improvement of the navigation route that will permit the river connection between existing communities in the extreme south-eastern territory and the rest of the country. The navigation channel will have the following dimensions: in its cross section it will be 20 meters wide on the bottom, 30 meters wide on the surface, and 2 meters deep in the dry season, along a stretch of 41,963.57 meters that extends from the site known as Punta Chingo Petaca until the Mouth of the San Juan River, as well as the construction of an access channel for the transportation of equipment to carry out the dredging, from the Caribbean to the Mouth of the San Juan River of Nicaragua, which will have the cross-section dimensions of 40 meters wide [at the bottom], 60 meters wide on the surface, a minimum depth of 6 meters, and a total length of 2,000 meters," as well as the clearing – using manual equipment – a *caño* [i.e., small channel] that connects the San Juan River to the Harbor Head Lagoon, in Nicaraguan territory. The clearing will be conducted along a length of 1,560 linear meters and up to a maximum of 30 meters wide, according to the reference coordinates North 1208638-East 863133 at the initial point, to final coordinates North 1209823-East 863450; and to clear, using a dredge, a stretch [of the San Juan River] that has filled with sediment, located in the reference coordinates North 1208439-East 863131 to (the end) coordinates North 1208134-East 863136 and North 1208138- East 863196, up to 59 meters wide, 300 meters long, and 6 meters deep, in which 37,500 m³ will be extracted, with the goal of facilitating navigation in those stretches.
In Nicaragua, the Ministry of Environment and National Resources (MARENA), the environmental regulatory entity, issued in 2008 an environmental permit through Administrative Resolution No. 038-2008 to the *Empresa Portuaria Nacional* [National Port Company] (EPN) as well as through an addendum to Administrative Resolution No. 038-2008-A1, issued in 2009 for the development of the project.
MARENA, by way of monitoring, organized and coordinated with others a monitoring inspection to verify the environmental compliance of the project located in the Municipality of San Juan de Nicaragua within the protected area "*Refugio de Vida Silvestre Rio San Juan*" [San Juan River Wildlife Reserve].
The instrument adopted to measure compliance with the prevention and mitigation measures was the Environmental Impact Study, as well as the Environmental Monitoring Program derived from that Study. The following environmental legal norms were also used: the Environmental Assessment Regulation (Decree 76-2006) [sic; correct: Decree 45-94], the

General Law on the Environment and its Regulations (Law 217) and its Revision (Law 647) and the Regulation of Nicaragua's Protected Areas (Decree No. 01-2007).

It is important to mention that the EPN designated an environmental specialist to ensure the supervision and compliance with the environmental measures, in accordance with that established in condition 11 of the Resolution 038-2008.

This report only contains the results of the visit to monitor the activities initiated at the time as part of the stages of the project.

OBJECTIVE OF THE INSPECTION

A. GENERAL OBJECTIVE

To evaluate the compliance with the provisions established in the Environmental Permit issued by the Ministry of the Environment and Natural Resources (MARENA) for the project ***IMPROVEMENT OF NAVIGATION IN THE SAN JUAN RIVER OF NICARAGUA*** through Administrative Resolution No. 038-2008 and its expansion (A-1).

Specific Objectives

• Verify compliance with the environmental provisions established in the environment permit and its expansion, in accordance with the environmental instruments and current regulations that apply.

• Evaluate the clearing and navigation improvement activities in the area where the beginning of the dredging activities is being carried out, a site known as the Finca José Sánchez, as well as the maintenance and manual clearing works in the Caño, a tributary of the San Juan River that empties into the Harbor Head Lagoon.

• Conduct a tour of the sites where sediments will be deposited along the 42 kilometer stretch, in order to ensure that the sites will be marked before the activities are conducted.

III. FIELD OBSERVATIONS:

The visit begins at the Project Campus located in the Municipality of San Juan de Nicaragua. In this site the administration and local management offices of the project.

At this same site they have established the storage point for the fuel to be used for the project, and to supply to the population if necessary.

Storage capacity:

• 4 tanks, each with the capacity to supply 1,000 gallons of diesel fuel

• 23 barrels where approximately 1,265 gallons of gasoline are supplied

• A tank with a capacity of approximately 250 gallons of gasoline

The fuel is transported by a barge from the facilities of the Petronic company in Puerto del Bluf to San Juan de Nicaragua.

Tour of Site 1:

In the field a brief meeting was conducted with personnel from the project, to whom it was explained that the objectives of the visit were oriented toward the environmental monitoring of the activities that had been initiated that included the cleaning of a stretch of the River that had become full of sediments using a dredge, located at reference coordinates North 1208439-East 863131 and North 1208134-East 863136 and North 1208138-East 863196 [to the end], with a georeferenced width of up to 59 meters, length of 300 meters, and depth of 6 meters.

[Photo] Photo: Location of the Dredge – North 1207586 and East 0207244

At the time of the visit, the equipment of the *Soberanía* Dredge was parked at the site, without conducting any activity; however, the dredging activities had advanced to approximately 40% (cut, suction, and deposition of sediments totaling 12,000 m³, according to the information supplied.

We observed the affect on vegetation that is characteristic to the area, which belongs to a very wet tropical forest (species like *Soto caballo*, *yolillales*, papaya tree, banana and grass cultivations, etc). Likewise, the area used for sediment deposits had been used for agricultural activities.

Site 1: Dredging progress in 40% of the area Site 1: Area already cleared of Vegetation (60%)

[Photo] [Photo]

All of the vegetation affected has been located on the left and right banks of this stretch in Nicaraguan territory. In 60% of the site, the trunks (stumps) of the trees have not yet been removed.

The sediment will be deposited in three sites, two of which have already been used to deposit approximately 12,000 m^3 of sediments. For the insertion of the tubing to the deposit site, an initial easement of approximately 10 meters wide was created.

At this site, 22 people are working in shifts of 11 people. A total of 42 gallons of used oil is generated per month. These wastes are stored in 55-gallon barrels with hermetic lids. It was observed that the solid wastes of domestic origin (plastic bottles, plastic plates and wrappers) were collected temporarily on site and later transported to a final deposit site in the town of San Juan de Nicaragua.

Vegetative wastes from the pruning of trees, primarily *yolillales* (palms) and grass vegetation, were also observed, which must be removed from the temporary site.

[Photo] Location of vegetative wastes

SITE No. 2: Works to maintain and clear the caño.

The clearing of the caño, tributary of the San Juan River that empties into the Harbor Head Lagoon in Nicaraguan territory, begins at coordinates North 1208638 and East 863133, observing the clearing of the navigation channel of approximately 10 meters wide (at the beginning) and between 1-1.2 meters of depth, with a length of around 1,560 meters. The works are conducted manually (using shovels, pickaxe and chainsaw used for tree pruning).

Distance toured during the inspection:

Point 1 (beginning) coordinates North 1208638 and East 863133

Point 2. Coordinates: North 1209162 and East 862956

Point 3. Coordinates: North 1209352 and East 862948

Point 4. Coordinates: North 1209564 and East 863011

Point 5. Coordinates: North 1209678 and East 863093

Point 6. Coordinates: North 1209728 and East 863436

Point 7 (exit into the Harbor Head Lagoon). Coordinates: North 1209823 and East 863450

The vegetation that was affected on the left bank of Nicaraguan territory is part of the very wet riparian and flooded forest of the caño, which obstructed the navigation of the channel. In these activities, around 248 people (male) are working, equipped with rubber boots, shovels and pickaxes for the manual work, and given that the water level was making these cleaning efforts difficult, other types of equipment might be required.

The solid wastes generated by the workers are managed in the same way as described for site 1.

[Photo] [Photo]

Type of vegetation on the banks (*yolillo* and grasses) Beginning of the manual clearing

[Photo] [Photo]

Sedimented caño and in its current state Exit from the caño toward Harbor Head

Mangrove type vegetation

SITE 3: Area of the 42 kilometers where the dredging activities will be conducted from the mouth of the San Juan River to the site known as Chingo Punta Petaca **(These activities have not commenced).**

One of the primary activities to be conducted before the work begins in this section is the on-site marking of the deposit sites.

CONCLUSIONS:

• The environmental impacts that have been generated by the project's activities are short-term and reversible, primarily the recuperation of vegetation.
• The impact on water quality conforms to the physico-chemical parameters and is considered to be of low intensity, inevitable, and is located along the stretch of the cleaning activities initiated with short duration and indirect effect. The recuperation of the physico-chemical parameters of the water (transparency, color and turbidity) depend on the quantity of solids dissolved in the water and will depend on how long the activity lasts, which is not considered significant because of the size of the sediments extracted, which confirm that the granulometry studies conducted for the project were correct.

RECOMMENDATIONS:
• EPN should present to MARENA in January 2011 its first trimester compliance report, in accordance with what is established in section 11 of Resolution 038-2008 and its expansion (A1).
• In light of the progress of the dredging activities in site 1, delimit the third area for depositing sediments, using primarily area that has been cleared of vegetation in order to reduce the impact on the flora and fauna of this ecosystem.
• Install ecological (mobile) latrines for the use of the personnel working on the project.
• Ensure the safety equipment and measures necessary to avoid working accidents, especially in the case of snakebites.
• At the campus site where fuel is stored, an anti-spill basin should be built, according to the relevant technical specifications.
Prepared by: Elsa Vivas Soto

Annex 164

Declaration of the Technical Manager of the National Port Company (EPN), Lester Antonio Quintero Gómez,

16 December 2010

[logo]

DECLARATION

I, Lester Antonio Quintero Gómez, Civil Engineer with Identity Card No. 001-0711-70-0014P, of Nicaraguan nationality, declare the following:

1. I am the Technical Manager of the *Empresa Portuaria Nacional de Nicaragua* (EPN) [National Port Company], which is the state agency charged with the development of port facilities in Nicaragua's marine, river, and lake regions, as well as all required port services required for the transportation of both people and goods. As part of my professional duties, I am personally involved in the coordination and implementation of the project "Improvement of Navigation on the San Juan River of Nicaragua."

2. Approximately six years ago, EPN began planning a project to improve the limited navigability of the final stretch of the San Juan River (Delta of the San Juan River to its mouth in the Caribbean), which had for many years been an obstacle to the development of commerce in the region. The navigability problem had become so severe that it was impossible to use even small personal boats on the River, especially during dry summer months. Photographic illustrations of the problem, as well as information on the small types of boats at issue, are attached as Annex 1.

3. In January 2006, EPN requested from the *Ministerio del Ambiente y los Recursos Naturals* (MARENA) [Ministry of the Environment and Natural Resources] approval for the dredging project. After follow-up consultations between EPN and MARENA, EPN was furnished with the Terms of Reference for the project on March 6, 2006 (Annex 2).

4. To help EPN develop a dredging plan, after requesting public offers for the consultancy work, EPN selected and hired the firm *Corea & Asociados S.A.* (CORASCO), a respected engineering and environmental consulting firm in Nicaragua.

5. In accordance with the terms of reference, EPN requested that CORASCO develop an Environmental Impact Study (EIS) in order to identify and analyze the environmental consequences of the dredging project.

[logo]

[logo]

6. The EIS and the final Project Design Study, which were approved by MARENA, contained a detailed analysis of: (1) likely changes in the flow of the San Juan and Colorado rivers as a result of the dredging project; (2) determination of the probable impact of the dredging operations on water quality and aquatic organisms; and (3) the potential environmental impact of the deposition of dredged sediments on the Nicaraguan bank. Relevant portions of the EIS and its supporting technical documentation are attached as Annex 3.

7. With respect to flow change, the Project Design Study analyzed a large quantity of measurement data to determine the possible changes in flows as a consequence of the dredging. Based on this quantitative analysis of data, the Project Design Study concluded that less than 5% of the flow of the San Juan River that presently goes to the Colorado River would continue to flow to the San Juan proper as a result of the dredging. (See pages 16-18 and 22 of the Project Design Study, and pages 10-13 and 71-73 of the EIS.)

8. With respect to the impact of the dredging on water quality and aquatic organisms, the EIS assessed sediment quality and particulate size in both the riverbed and dissolved in the water at various key points in the River. Using a "cause-effect matrix" in conjunction with data about sediment quality and particulate size, the EIS determined that the dredging would cause no long-term effect on any water quality parameter or aquatic life. (See pages 10-13, 59-67, 169-172, 198-203 and 208-212 of the EIS.)

9. With respect to deposition of the dredged sediments, EPN, CORASCO, MARENA, and the members of the intra-governmental team that reviewed the project worked together to design a protective protocol for depositing the dredged sediments in barriered sites in carefully selected locations on the Nicaraguan side of the River at least 50 feet from the River bank. That protocol was incorporated into the final EIS in order to ensure that the extracted sediments will not return to the River or harm the environment or nearby communities. (See pages 22-28, 169-170, 173-174, 188-198, 208-212 and 222-223 of the EIS.)

[logo]

[logo]

10. [T]he Environmental Permit received from MARENA for the project…contemplates the implementation by sector according to the following:

VOLUMES TO BE DREDGED

SECTION OF 2.0m, 20X30M

Number	Beginning		End		Volume (m^3)	Accumulated (m^3)
1	Caribbean Sea	0+000	Mouth of the River	1+000	106,496.21	106,496.21
2	Mouth of the River	1+000	San Juanillo River	8+600	287,454.41	393,950.62
3	San Juanillo River	8+600	El Zapotal	16+530	408,491.28	802,441.90
4	El Zapotal	16+530	El Jobo	23+900	300,800.88	1,103,242.78
5	El Jobo	23+900	Reyes	28+800	144,483.98	1,247,726.76
6	Reyes	28+800	Delta	33+500	88,785.21	1,336,511.97
7	Delta	33+500	Punta Petaca	42+046.92	12,339.60	1,348,851.57
8	Mouth of the River		San Juan de Nicaragua	3+894.34	134,528.19	1,483,379.76
9	Alternate Route (Est 6+176.86 to 6+237.20				75,106.45	1,558,486.21
10	Dock of municipal pier of San Juan de Nicaragua				16,109.40	1,574,595.61
			Total (m^3)		1,574,595.61	

The total projected cost of the dredging project is US$ 7,533,124.80 (seven million, five hundred thirty-three thousand, one hundred twenty four American dollars, and 80 cents).

11. Although the project as originally approved by MARENA entailed the extraction of 1,574,595.61 cubic meters of sediments from the San Juan River, due to budgetary constraints the scope of the project has been reduced so that only 942,564.35 cubic meters of sediments will be extracted. The project will now take the following form:

[logo]

[logo]

a. Dredge from San Juanillo to El Zapotal, a total distance of 7.93 kilometers and a total volume of 408,494.28 m^3 of extracted sediments;

b. Dredge from El Zapotal to El Jobo, a total distance of 7.37 kilometers and a total volume of 300,800.88 m^3 of extracted sediments;

c. Dredge from El Jobo to Reyes, a total distance of 4.9 kilometers and a total volume of 144,483.98 m^3 of extracted sediments; and

d. Dredge from Reyes to El Delta, a total distance of 4.7 kilometers and a total volume of 88,785.21 m^3 of extracted sediments.

12. Moreover, as a result of this more gradual and limited approach, EPN modified the dredging project and decided to utilize smaller dredges available in Nicaragua instead of the larger dredges it had initially intended to procure from abroad. The specifications of these small Nicaraguan dredges are attached as Annex 4.

13. Dredging began on 17 October 2010, but it has been delayed as a result of substantial mechanical problems with the one dredge currently available for use, the *Soberanía*. Although the current schedule calls for the dredging of the River from San Juanillo to Delta to be conducted over the next sixteen months, it is unlikely that this phase of the dredging work will be completed on schedule.

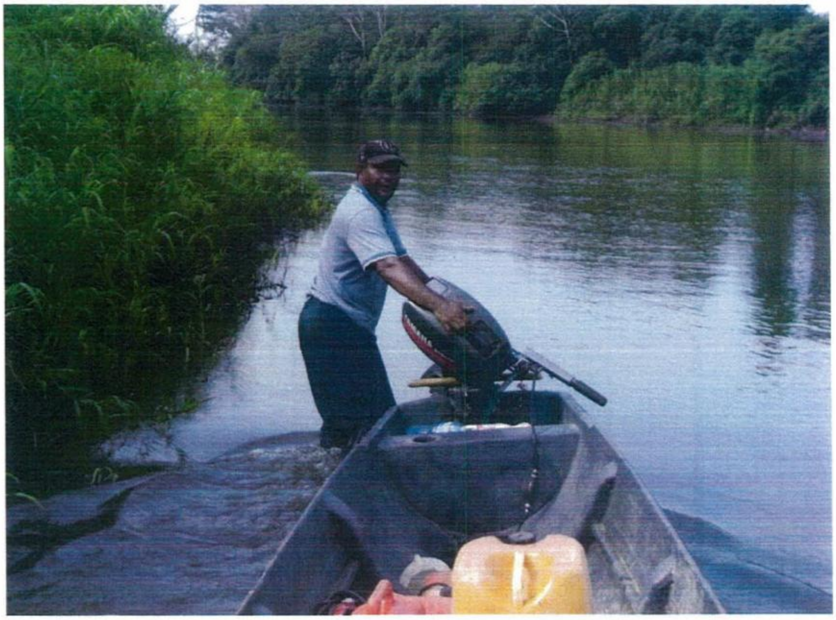
Signed this sixteenth day of December in the year two thousand and ten.

[Signature; Seal]

Lester Antonio Quintero Gómez
Technical Manager
National Port Company

[logo]

QUINTERO ANNEX 1




Enduro

Annex 165

Affidavit of Hilda Espinoza Urbina, National Director of the Department of Environmental Quality at the Ministry of the Environment and Natural Resources of Nicaragua (MARENA).

20 December 2010

AFFIDAVIT OF HILDA ESPINOZA URBINA, NATIONAL DIRECTOR OF THE DEPARTMENT OF ENVIRONMENTAL QUALITY AT THE NICARAGUAN MINISTRY OF THE ENVIRONMENT AND NATURAL RESOURCES

A. Background and Introduction

1. My name is Hilda Espinoza Urbina. I am the Director of the *Dirección General de Calidad Ambiental*, or Department of Environmental Quality, at Nicaragua's *Ministerio del Ambiente y los Recursos Naturals* (MARENA), or Ministry of the Environment and Natural Resources. MARENA is charged with ensuring the conservation, protection, and sustainable use of Nicaragua's environment and natural resources. As such, MARENA is the Nicaraguan agency with the most direct control over the environmental impacts of the project entitled "Improvement of Navigation in the San Juan River of Nicaragua."

2. One of MARENA's key responsibilities is its administration of the *Sistema de Evaluación de Impacto Ambiental*, or the Environmental Impact Assessment Program ("EIA Program"), which is coordinated through my Department. Through the EIA Program, we work to ensure not only that the environmental impacts of all projects have been properly and adequately analyzed before the projects are authorized to commence, but also that all projects, once authorized, are carried out in compliance with all applicable environmental requirements. In this way, MARENA ensures that all projects authorized in Nicaragua comply with the rigorous standards set forth in Nicaragua's environmental laws and regulations in order to prevent unacceptable impacts to the environment.

3. I have personally overseen the review and permiting processes utilized for all aspects of the project entitled "Improvement of Navigation of the San Juan River of Nicaragua." As permitted, that project includes the dredging of the last 42 kilometers of the San Juan River, which has barely begun, as well as the manual cleaning of the Harbor Head Caño, which has already been completed. As is discussed in more detail below, all applicable environmental laws and regulations have been strictly observed during the permiting of the project, which MARENA determined would not pose any risk of significant, unacceptable, or irreparable environmental harm. Moreover, under my direction, MARENA has ensured and will continue to ensure that all aspects of the project are carried out in full compliance with all the requirements established in the permits issued.

B. Legal Structure of Nicaraguan Environmental Laws and Protections

4. Protection of the environment is of central importance in Nicaragua. Indeed, the Constitution explicitly provides that the Nicaraguan people have the right to live in a healthy environment and requires the Government of Nicaragua to guarantee that right by ensuring "the preservation, conservation, and restoration of the environment and natural resources" (Article 60, Annex 1 hereto).

5. Nicaragua's constitutional protection of the environment is enforced through a legal framework designed to ensure responsible environmental management, conservation of natural resources, and sustainable development.

6. An essential part of this legal framework is Law 217, and its revisions in Law 647. (Relevant portions are attached as Annex 2.) Law 217, the General Law on the Environment and Natural Resources, was enacted in 1996 and broadly establishes standards, mandates, and principles for the Government's conservation, protection, improvement, and restoration of Nicaragua's environment and natural resources. Included in Law 217's mandate is the requirement that a precautionary approach be taken in managing any activities that have the potential to impact the environment, and when there is any doubt about the impact or negative environmental consequences of some action or omission, preventative measures must be taken, even where there is no scientific evidence that harm will occur (Law 217, Article 4, 3 and Law 647, Article 2).

7. The Government of Nicaragua assures its compliance with Law 217 and its revisions through MARENA's administration of the EIA Program. Pursuant to this program, any project with the capacity to materially impact the environment must be approved by MARENA before being commenced (Law 217, Article 25). This is true even of very small projects, so long as they are capable of significantly affecting the environment. Any proposed project located in an environmentally sensitive or protected area – including the San Juan River Wildlife Reserve – requires authorization from MARENA. (Decree 01-2007, Article 54, attached as Annex 3).

8. Parties that undertake any projects without proper approval are subject to sanction, which can range from administrative penalties such as fines and injunctions, to criminal sanctions including imprisonment.

9. Although different categories of projects are subject to different review procedures, all projects capable of affecting the environment are subjected to a review process that is carefully calibrated to ensure that the potential environmental impacts are identified and analyzed and that all steps necessary to avoid unacceptable environmental consequences are implemented. The foundational elements of any review are as follows:

   a. The process begins when the proponent of the project sends a request for a permit to MARENA;

   b. Having received the request, MARENA must conduct at least one inspection of the site of the proposed project, although it may conduct as many as it sees fit and require the project proponent to provide whatever further information is desired;

c. After the review process is complete, MARENA issues a resolution either granting or denying the requested permit. MARENA will only grant a permit when it has determined that the project will not cause any significant change to any environmental component, whether biotic, abiotic, socioeconomic, cultural, or aesthetic;

d. A resolution authorizing a particular project will itemize all of the obligations of the party responsible for the project in order to prevent unacceptable environmental impacts;

e. MARENA is authorized to sanction parties who fail to comply with the requirements established in the environmental permits issued to them; and

f. In every permit, MARENA retains the power to modify environmental requirements as necessary and to demand the cessation – either temporary or permanent – of a project that is found to be in violation of its environmental authorization.

10. Under the EIA Program, certain categories of projects, including dredging works involving the use of certain equipment, require a formal technical analysis of environmental impacts. The analysis was long governed by Decree 45-94 (subsequently superseded by Decree 76-2006), Rules on Permits and Environmental Impact Assessment (attached as Annex 4), which establishes that the following additional procedures are required for projects within the scope of the Decree:

a. An intra-governmental team must be assembled of whichever officials have relevant expertise given the specific characteristics of the proposed project. The purpose of such mandatory intra-governmental cooperation is to ensure that all the different aspects and potential impacts of the project – environmental and otherwise – are properly considered during the evaluation of the project. MARENA oversees and coordinates the intra-governmental team.

b. After a review of the preliminary information provided by the proponent as well as at least one mandatory site visit, the team develops Terms of Reference to guide the formal technical analysis of the proposed project.

c. The proponent must utilize the Terms of Reference in preparing an *Estudio de Impacto Ambiental*, or Environmental Impact Study, which must present the technical and scientific information necessary to identify, predict, evaluate, and control the environmental impacts of the proposed project. The proponent must revise, augment, or clarify the Environmental Impact Study in whatever way requested by the intra-governmental reviewing team.

d. The proponent must also submit a *Documento de Impacto Ambiental*, or Environmental Impact Document, which must report all the findings of the Environmental Impact Study in language that a layperson can understand.

e. The Environmental Impact Document must be made available to the MARENA delegation responsible for the territory at issue, the mayor of the municipality where the proposed project is to take place, and the public at large. Notice must be published informing the public of how it can access the Environmental Impact Document for review and comment.

f. Once a final version of the Environmental Impact Study is submitted, together with all public comments and additionally requested information, the intra-governmental team must conduct a technical review and issue a *Dictámen Técnico*, or Technical Opinion, incorporating all relevant information and explaining the team's findings and recommendations.

g. If, according to the intra-governmental team, the proponent has satisfactorily demonstrated that the proposed project is safe and does not pose a threat of unacceptable environmental impacts, MARENA will issue a resolution granting the requested environmental permit, complete with whatever environmental requirements it deems appropriate.

h. After issuing a resolution granting a permit, MARENA retains jurisdiction over the proposed project to ensure that it is implemented in accordance with all specified requirements. A violation of the requirements included in the resolution is grounds for sanction, including an order cancelling the authorization and halting the project.

11. Like all governmental officials in Nicaragua, MARENA personnel are obligated to observe all the foregoing requirements, and the failure to do so presents not only the possibility of termination, but also the risk of personal liability for any harm caused as a result of the failure to observe the relevant laws or regulations. That is, if a particular project were permitted by MARENA in violation of established legal principles or the relevant legal framework, my colleagues and I would face personal liability for any harm caused by the project.

C. MARENA's Initial Decision to Authorize the Project

12. On 25 January 2006, MARENA received a letter from the *Empresa Portuaria Nacional* (EPN), or National Port Company – a state-owned Nicaraguan entity – requesting an environmental permit to dredge the final 42 kilometers of the San Juan River that extends from Punta Petaca, upstream from the Colorado River, to the Caribbean Sea.

13. Promptly thereafter, a team of officials from various relevant governmental institutions was formed to evaluate EPN's request. This intra-governmental team,

which was overseen and coordinated by various technical experts from my Department at MARENA, included representatives and technical experts from: the *Secretaría Ejecutiva de la Reserva de la Biósfera del Sureste de Nicaragua*, or Executive Secretariat for the Preservation of the Southeast Nicaraguan Biosphere; the *Instituto Nicaragüense de Estudios Territoriales* (INETER), or the Nicaraguan Institute for Territorial Studies; the *Dirección General de Transporte Acuático del Ministerio de Transporte e Infraestructura* (DGTAN-MTI), or Department for Water Transportation of the Ministry of Transportation and Infrastructure; and MARENA's Territorial Delegation for the San Juan River.

14. On 9 March 2006, I transmitted to EPN the Terms of Reference for the dredging project (attached as Annex 5), which the reviewing team had developed based on the information so far provided by EPN, as well as an on-site inspection. Those Terms explained that EPN was expected to ensure compliance with environmental laws and take into consideration the fact that the project was to take place in a RAMSAR wetland of international importance – the *Refugio de Vida Silvestre Río San Juan de Nicaragua*, or San Juan River Wildlife Reserve. They specifically required analysis of potential hydrological changes, impacts on water quality caused by suspended sediments, harm to existing ecosystems or endangered species, and impacts resulting from the depositing of extracted sediments.

15. EPN submitted its first version of the Environmental Impact Study to MARENA on 20 July 2006. On 27 July 2006, I informed EPN that the documentation provided was incomplete, as it did not present sufficient substantive technical information to support the conclusions reached regarding the environmental impacts the project might cause.

16. MARENA received an Environmental Impact Document from EPN on 7 August 2006. That Document was made available to the public for review and commenting from 9-15 August 2006 at the offices of the MARENA Territorial Delegation for the San Juan River in San Carlos, the Town Hall of El Castillo, the Town Hall of San Juan del Norte, and MARENA's central offices in Managua. EPN had published notices of this availability in *La Prensa* and *El Nuevo Diario* on 7 August 2006 (attached as Annex 6). The team reviewed all comments and took them into consideration.

17. After various substantive meetings between EPN, its professional technical consultants from *Corea & Asociados S.A.* (CORASCO), and the intra-governmental reviewing team, on 22 September 2006, EPN submitted to the team its revised Environmental Impact Study, including substantial technical annexes and a detailed Project Design prepared by CORASCO. After reviewing the augmented information and conducting its fourth site inspection, MARENA requested additional information from EPN regarding the sites where extracted sediments were to be deposited. EPN responded to those new requests for information.

18. Having reviewed all the information provided by EPN and CORASCO, all the comments that had been submitted, and all the knowledge gathered during its many meetings and visits to the site, the intra-governmental reviewing team issued its Technical Opinion regarding the project on 28 November 2008 (attached as Annex 7). The Technical Opinion concluded that the project would cause no significant, irreversible impact on the environment and provided recommendations for mitigation measures.

19. Based on the Technical Opinion, on 22 December 2008, I, in my capacity as Director of MARENA's Department of Environmental Quality, signed Resolution No. 038-2008 (attached as Annex 8), which granted approval to EPN for the dredging project. I signed that Resolution only after my staff and I were fully satisfied not only that all required procedural steps had been strictly observed, but also that sufficient high-quality technical information had been provided to confirm that the project was environmentally viable because it would not cause unacceptable environmental consequences.

20. Specifically, by December 2008, we were satisfied that EPN had:

a. Provided detailed information about the existing environmental conditions in and around the San Juan River, including those present in Costa Rican territory, such as relevant flow rates, data on water and sediment quality, the geological and hydrological characteristics of the region, a survey of the flora and vegetation species in the area of influence, and information on the region's biodiversity;

b. Demonstrated that the proposed dredging project was necessary to provide the citizens of the municipality of San Juan de Nicaragua with access to basic public services guaranteed to them by the Nicaraguan Constitution (*e.g.*, Article 105, Annex 1, which requires the Government to protect the "inalienable right" of access to adequate transportation services and infrastructure);

c. Conducted a thorough and detailed assessment of potential environmental impacts resulting from the dredging project, including the effect of the actual dredging efforts on water quality and aquatic life, as well as the effect of depositing extracted sediments on the Nicaraguan shore – which are the two environmental impacts that must always be evaluated for dredging projects;

d. Established through its Environmental Impact Study, as augmented and refined, that the dredging project was not likely to have any significant adverse impact on the environment, let alone any significant irreversible impact. This included any harmful impacts on the people, property, or environment of Costa Rica, as EPN had adequately established that the dredging itself would not significantly affect the San Juan River or the flora, fauna or abiotic characteristics of its zone of influence – whether on the Nicaraguan or Costa Rican side – and that none of the byproducts of the dredging work were to be deposited on the Costa Rican side of the River;

e. Demonstrated that the dredging project would have positive effects, not only for the Nicaraguan people who live in the area, but also for the San Juan River itself and its zone of influence, including a reduction in erosion and sedimentation due to the careful reforestation of portions of the Nicaraguan bank, as well as the restoration of the mangrove swamps near the River's mouth and the many species that depend on the health of those swamps and the rest of the River for their well-being; and

f. Provided convincing evidence in its Environmental Impact Study and supporting documentation – including substantial bathymetrical data and flow calculations – that the dredging of the San Juan River would not significantly affect the flow of the Colorado River in Costa Rica, which would be reduced by a few percentage points at most, and even less in the rainy season. The intra-governmental team had specifically requested and reviewed all the technical data and calculations forming the basis for EPN's conclusions on this point. Ultimately, it was determined that CORASCO's data collection and calculations had been conducted in the proper professional manner, and that they did, indeed, support the conclusion that the project would not harm the navigability of the Colorado River.

21. To ensure that the dredging project would not cause unacceptable environmental consequences, substantial conditions were incorporated into Resolution No. 038-2008 mandating that certain requirements be satisfied in the implementation of the project, including:

a. That any extracted sediments be analyzed and disposed of in specific locations and in specific ways, taking care to preserve vegetation and ensure that the sediments not be returned to the River;

b. That measures be taken to prevent the spill or spread of the fuels used to power the dredging equipment;

c. That care be taken to protect the flora and fauna of the environment;

d. That every stage of the project be overseen by a qualified environmental professional provided by EPN, who would receive instructions from MARENA as necessary; and

e. That EPN pay for the services of a seperate environmental inspector to be appointed by MARENA's Delegation for the San Juan River region.

D. MARENA's Decision to Authorize the Caño Clearing Addition to the Project

22. On 28 August 2009, after MARENA had authorized the dredging project, EPN's legal representative, Virgilio Silva, submitted an application to expand the work approved in Resolution No. 038-2008 to include the "manual cleaning of the caño [i.e., small channel] that connects the San Juan River to the Harbor Head Lagoon" – also known as the Harbor Head Caño. This addition was to include the removal with hand-held tools of the accumulated debris and overgrown vegetation that were impeding normal navigation in the Harbor Head Caño.

23. Before authorizing the additional work, MARENA conducted an environmental review as required in order to ensure that the clearing of the Caño, which is located in a protected area, would not cause material harm to the environment. This review was carried out in conformity with the applicable legal requirements set out in the laws and decrees described above, which, in the case of strictly manual works of such a small scope, do not mandate the preparation of a seperate Environmental Impact Study.

24. The initial bases for MARENA's environmental review of the proposed caño clearing were two reports that EPN had submitted as part of its application for permission to complete work. The two reports were:

a. A General Information report which explained that it was necessary to add to the original dredging plan "the clearing of the caño that connects the San Juan River to the Harbor Head Lagoon" in order to satisfy the overarching goal of ensuring year-round navigability of the whole River "with adequate access channels," such as the Harbor Head Caño. According to this General Information report, the cleared Caño would ensure "an alternative, more direct navigation route, thereby reducing the time required to travel between different sites along the River" which would "reduce not only the cost of transportation, but also the consumption of fuel."

b. An Environmental Management Plan, which not only described the proposed work, but also identified and evaluated its potential environmental impacts, established how such impacts would be prevented, mitigated, and reversed, if necessary, and outlined the supervision that would be provided to ensure proper environmental management.

25. After reviewing the information provided by EPN in these two reports, MARENA continued its environmental review by inspecting the site of the proposed work. Specifically, on 7-8 September 2009, two qualified officials from my Department accompanied the Technical Director from EPN on a visit to and through the

Harbor Head Caño in order to understand fully the proposal, how the work would be carried out, and its likely environmental impacts.

26. The findings of the on-site visit were reported to me and other MARENA personnel in a written Technical Report (attached as Annex 9), which explained in relevant part that the proposed work consisted in the "maintenance and cleaning of the caño, a tributary of the San Juan River that empties into the Harbor Head Lagoon, in Nicaraguan territory," which would be cleared "using shovels, pickaxes, and chainsaws for pruning, and the cutting of trees if necessary," in order to expose the 1,560 meter length of the Caño to a width of approximately 30 meters.

27. The Technical Report also offered a series of specific recommendations for the prevention and mitigation of any environmental impacts, including:

a. That the work be conducted by hand;

b. That any extracted sediments be handled appropriately and deposited in specific locations on the Nicaraguan bank to reduce any impact to flora or fauna and to prevent the sediments from returning to the Caño;

c. That all removed debris be transported off-site and disposed of properly;

d. That mobile eco-friendly latrines be provided for the use of the workers;

e. That, for any tree felled during the process, ten more of a native species be planted in its place, in order to promote the regeneration of natural species in the event that some cutting is unavoidable; and

f. That the activities be overseen by EPN's environmental supervisor, and approved by a MARENA official.

28. Taken together, all of this information allowed my staff and me to conclude that that, as proposed, the work to clear the Harbor Head Caño would not cause any significant, irreparable impacts to the environment. First, based on the information provided by EPN, including all the technical data on the characteristics of the San Juan River provided during the initial permiting process, there was no reason to believe that a small manual cleaning effort would have a meaningful impact on the flow, course, or water quality of the San Juan River or other related waterbodies. We also determined that, in a swampy area like Harbor Head where vegetation regenerates quickly, the manual clearing of the plants and debris obscuring the caño would not have any long-term effects, and that any short-term impacts could be prevented by requiring the proper disposal of debris and mitigated by requiring the replacement of any damaged native vegetation.

29. Because my staff and I were satisfied that the proposed caño clearing work would not cause unacceptable environmental consequences and was necessary for the fulfillment of EPN's goal of ensuring the year-round navigability of the San Juan River by small boats, on 30 October 2009, I signed Administrative Resolution No. 038-2008-A1 (attached as Annex 10), which expanded the original dredging project to grant EPN the environmental authorization to commence work on the caño clearing under the specific conditions that had been recommended by my colleagues.

E. MARENA's Monitoring Efforts to Ensure Compliance

30. MARENA is obligated by law to ensure that EPN observes all the environmental requirements included in both of the environmental permits issued to EPN for the "Improvement of Navigation in the San Juan River of Nicaragua," including the clearing of the Harbor Head Caño. In furtherance of this obligation, a group of MARENA officials conducted on-site visits in both the River and the Caño from 24 to 26 November 2010. The findings of those visits (attached as Annex 11) include the following:

   a. By the time of MARENA's visit to the River, EPN had extracted and properly disposed of some 12,000 cubic meters of sediments in an area upstream from and unrelated to the Harbor Head Caño, but the dredger, known as the *Soberanía*, was not functioning and progress on the dredging of the San Juan River had stalled completely;

   b. The clearing of the Caño was proceeding pursuant to the requirements of Administrative Resolution No. 038-2008-A1 because it was being conducted manually in the existing Caño and was affecting only the Nicaraguan side of the River, all cleared sediments were being properly handled and deposited, and all debris was being disposed of correctly;

   c. The work was generating only reversible, short-term impacts on vegetation, which would quickly regenerate naturally;

   d. The work was generating only the expected low-intensity, reversible, and insignificant effects on water quality, because EPN's sediment studies were proving to have been accurate; and

   e. EPN had satisfied its obligation to appoint an environmental specialist to ensure the supervision of the project and compliance with all environmental requirements.

31. Since the November 2009 site visits, MARENA has confirmed that the clearing of the Caño is complete, that it was conducted entirely manually, and that the process of replanting native vegetation in order to replace at a ratio of ten to one each of the trees that was cut has commenced.

32. My staff at MARENA and I are continuing to monitor the dredging project, in accordance with our legal obligations, to ensure that EPN continues to operate entirely within the bounds of the environmental permits that we have issued, and to take any measures that might be required to prevent or reverse any unforeseen environmental impacts that might arise.

Signed this twentieth day of December, 2010, in the city of Managua, Nicaragua.

H. Espinoza

Hilda Espinoza Urbina
Director of the Department of Environmental Quality
Ministry of the Environment and National Resources of Nicaragua