INTERNATIONAL COURT OF JUSTICE

DISPUTE CONCERNING THE CONSTRUCTION OF A ROAD IN COSTA RICA ALONG THE SAN JUAN RIVER

NICARAGUA *v.* COSTA RICA

COUNTER-MEMORIAL OF COSTA RICA

VOLUME I

19 DECEMBER 2013

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Chapter 1

Introduction

A. Overview of the dispute

1.1 The boundary regime applicable between Costa Rica and Nicaragua is that established by the 1858 Treaty of Limits,[1] as interpreted and applied in subsequent arbitral awards and judicial decisions.[2] That regime establishes and defines the boundary, certain common areas and facilities, and concurrently stipulates Costa Rica's perpetual right of free navigation for purposes of commerce and for the benefit of riparians along the Costa Rican bank. Nicaragua's actions over the past several years have demonstrated a policy of disregard for that well-established boundary regime.

1.2 Faced with the risk of a further violation of its sovereignty and territorial integrity, Costa Rica undertook urgent infrastructure works to improve access to the police posts and remote communities located along its border. Costa Rica's response – consolidating pre-existing dirt tracks and constructing new stretches of road – was peaceful and conducted entirely within its own territory.

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1 NM, Annex 5.

2 The relevant arbitral awards and judicial decisions are:

- the Cleveland Award, NM, Annex 6(1);
- the Alexander Awards, NM, Annexes 6(2)-(5); and
- the decision of this Court in *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 213.

1.3 In its Memorial, Nicaragua criticises Costa Rica's decision to take those urgent measures.[3] However, it is not for Nicaragua to challenge the decision of another State to undertake urgent infrastructure works entirely within its own territory. As to substantive obligations, Nicaragua may only complain if and to the extent that there has been significant transboundary harm. As to obligations of notification and assessment, Nicaragua chooses to ignore the pressing circumstances in which the Road was constructed, which derive from its own unlawful and/or provocative conduct. Those pressing circumstances are further particularised in Chapter 2 below.

1.4 As to actual harm, Nicaragua claims that "massive"[4] and "enormous"[5] amounts of sediment have already been deposited in the San Juan River and that erosion has "astronomically accelerated".[6] This grossly overstates the volume of sediment that has or could have resulted from the construction of the Road: as will be demonstrated in Chapter 3, on the worst-case analysis the volume of added sediment is insignificant having regard to the sediment load of this sediment-heavy River. *A fortiori* Nicaragua grossly exaggerates any actual transboundary impact the works could possibly have had. In fact (as will be demonstrated here) there has been no significant effect. Indeed Nicaragua — on whom the burden of proof lies — has not established that it has suffered *any* resulting harm from any additional sediment, let alone significant harm of the character and

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3 See e.g. NM, paras. 1.9 and 5.20.

4 NM, para. 1.9. See also e.g. NM, para. 3.60.

5 NM, para. 3.2.

6 NM, para. 3.77 (quoting Dr. Kondolf). Nicaragua also exaggerates that, for example, the Border Road "importantly worsened the already critical situation of the sediments within the River" and that it has had a "tremendous" impact and resulted in "irreparable" harm: NM, paras. 2.35, 4.19 and 5.67.

dimensions it alleges and would have to establish in order to have a cause of action.

1.5 As to the risk of future harm, this again is grossly overstated in the Memorial, and for essentially the same reasons.

1.6 This Chapter outlines the physical geography of the relevant area (**Section B**), describes the Border Road[7] (**Section C**) and provides an overview of the circumstances which led to the infrastructure works on the Road (**Section D**). The jurisdiction of this Court is then considered (**Section E**), and finally an outline of the remainder of the Counter-Memorial is provided (**Section F**).

B. Physical geography of the relevant area

1.7 The San Juan-Colorado rivers basin is the largest in Central America. It drains a catchment of an area of some 40,000 km^2 in size from both Costa Rican and Nicaraguan basins.[8] **Figure 1** shows the size of this bi-national basin. Lake Nicaragua (Cocibolca), where the San Juan River originates, discharges around 16% of the total water flow, while Costa Rican tributaries provide 70% and Nicaraguan tributaries 14%.[9] If the discharge from Lake Nicaragua is excluded, Costa Rican tributaries alone account for 83% of the overall water flow of the San Juan-Colorado

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7 The Border Road is not a "Highway", as Nicaragua claims; cf. NM, paras. 2.26, 5.2 and 5.106.

8 **Appendix A**, Professor Colin Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, para. 6.44.

9 **Vol 2, Annex No 4**, Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River*, August 2013, Table 4, p. 14.

Rivers.[10]

Figure 1. Bi-national basin of San Juan-Colorado rivers. Source: "PROCUENCA. Diálogo sobre agua y Clima. Enfrentando la variabilidad del clima en una cuenca transfronteriza de América Central: La cuenca del río San Juan (Costa Rica y Nicaragua)". Available at: http://www.oas.org/sanjuan/spanish/documentos/dialogo/dialogo/01-characterization/mapas/map1.html

1.8 The San Juan River extends over approximately 205 km from its source in Lake Nicaragua to its outlet in the Atlantic Ocean. Some 30 km

10 **Vol 2, Annex No 4**, Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River*, August 2013, Table 4, p. 14.

before it reaches its outlet, at the Delta, the San Juan River branches into the Lower San Juan River to the north, and the Colorado River to the south. The Colorado River, which runs entirely within Costa Rican territory, receives around 90% of the water flow from the upper San Juan River;[11] the lower San Juan River receives the remainder.

1.9 The majority of the basin is 500 m above sea level, rising from the Caribbean coast plains, which are the flood plains of the Río Indio-Maíz (in Nicaragua) and Tortuguero (in Costa Rica), to the high plateaus, 1,500 - 3,000 m above sea level in northern Costa Rica, and a little over 1,600 m above sea level in Nicaragua. This topography greatly influences the rainfall in the region, which varies between 4,000 and 6,000 mm in the more humid areas, and between 1,000 and 2,000 in the drier areas surrounding Lake Cocibolca where the dry season lasts approximately seven months of the year. The annual average temperature ranges between 20°C and 28°C, although at higher altitudes it may decrease to less than 10°C.[12]

1.10 The San Juan-Colorado basin carries large amounts of sediments. The average annual total sediment load (i.e. suspended load and bed load) carried between December 2010 and June 2013, as measured by the responsible Department at the Costa Rican Institute of Electricity, was around 9 133 000 t yr^{-1}. At the Delta (where the upper San Juan River branches into the two distributaries), 8 470 000 t yr^{-1} flow into the Colorado

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11 **Appendix A**, Professor Colin Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, para. 8.9.

12 PROCUENCA. Diálogo sobre agua y Clima. Enfrentando la variabilidad del clima en una cuenca transfronteriza de América Central: La cuenca del río San Juan (Costa Rica y Nicaragua), available at: http://www.oas.org/sanjuan/spanish/documentos/dialogo /dialogo/01-characterization/04-abstract.html.

River and 663 000 t yr^{-1} into the lower San Juan River.[13] In the *Navigational Rights case*, Nicaragua acknowledged that the river carried over 10 200 000 t yr^{-1} of sediment.[14]

C. Description of the Border Road

1.11 In light of the circumstances described in the following sub-section, and set out in greater detail in Chapter 2, Costa Rica commenced road works entirely within its own territory. Road works were first carried out so as to provide access to the area bordering Nicaragua along the San Juan River. These access routes leading to the border area comprise approximately 382.7 km of road.[15] Costa Rica also undertook road works in the border area itself, so as to create a single road running parallel to the San Juan River and further inland called *Route 1856 Juan Rafael Mora Porras* (See **Sketch Map** 1).[16] This road (hereafter the Border Road or simply the Road) runs from Los Chiles to Delta Costa Rica, and is approximately 159.7 km in length. Much of it (101.5 km or 63.6%) was built on pre-existing rural roads or tracks.[17] Of the 159.7 km, approximately 108.2 km of the Road runs between Marker II and Delta Colorado,[18] i.e. the area where

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13 **Appendix A**, Professor Colin Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, para. 8.56.

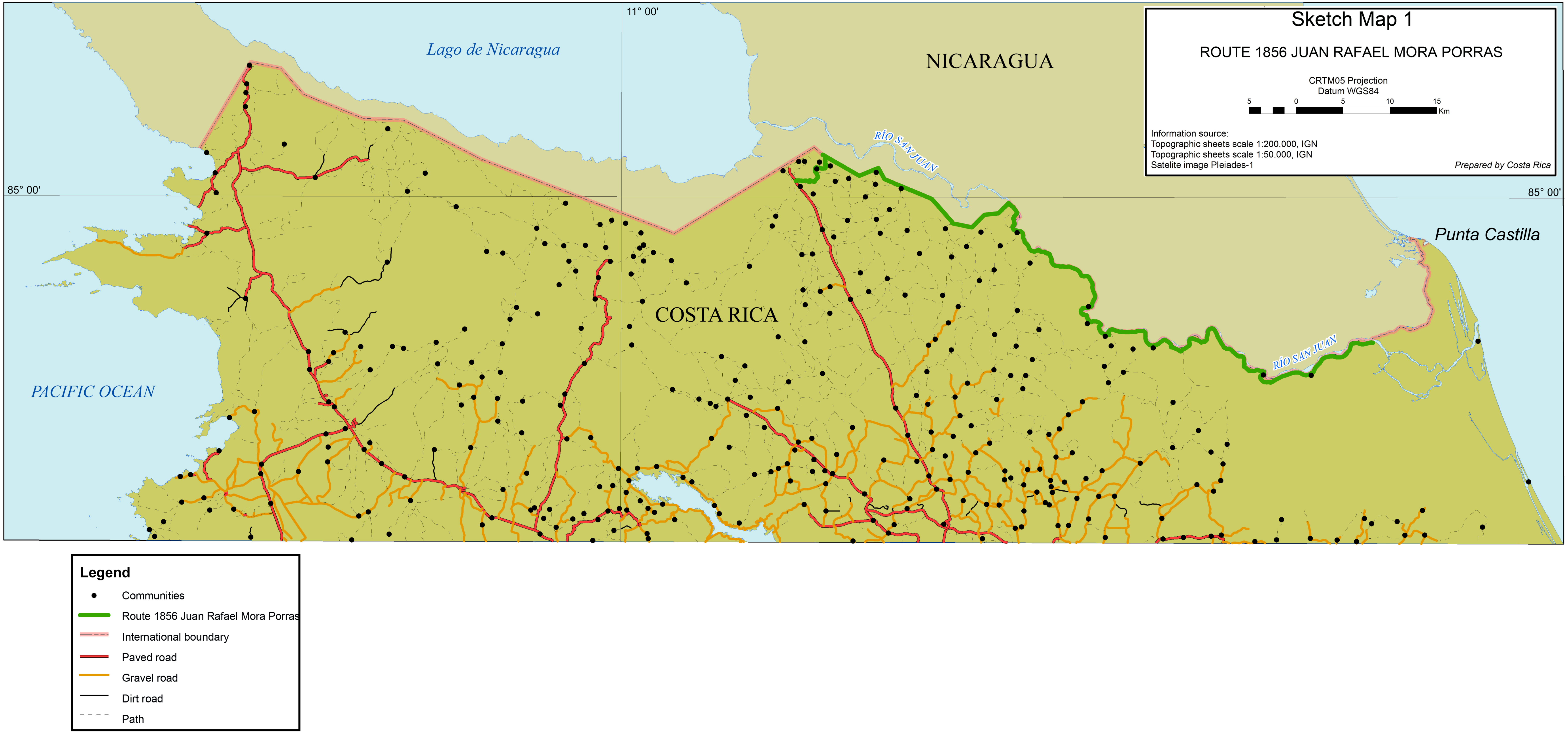
14 See *Dispute Concerning Navigational and Related Rights (Costa Rica v. Nicaragua)*, NCM, para. 1.1.8.

15 **Vol 2, Annex No 3**, Allan Astorga G. and Andreas Mende, *Route 1856: Analysis of the Change in Land use Based on Satellite Images Before and After the Construction of the Border Road*, August 2013, p. 6.

16 The name of the Border Road was explained by the Ambassador Edgar Ugalde Álvarez, Agent of Costa Rica, in CR 2013/29, p. 8, para. 2 (Álvarez).

17 **Vol 2, Annex No 3**, Allan Astorga G. and Andreas Mende, *Route 1856: Analysis of the Change in Land use Based on Satellite Images Before and After the Construction of the Border Road*, August 2013, p. 6.

18 *Ibid*, p. 4.



Sketch Map 1
ROUTE 1856 JUAN RAFAEL MORA PORRAS
CRTM05 Projection
Datum WGS84
5 0 5 10 15
Km
Information source:
Topographic sheets scale 1:200.000, IGN
Topographic sheets scale 1:50.000, IGN
Satelite image Pleiades-1
Prepared by Costa Rica
Lago de Nicaragua
NICARAGUA
COSTA RICA
PACIFIC OCEAN
Punta Castilla
RÍO SAN JUAN
RÍO SAN JUAN
11° 00'
85° 00'
85° 00'
Legend
Communities
Route 1856 Juan Rafael Mora Porras
International boundary
Paved road
Gravel road
Dirt road
Path

the right margin of the San Juan River marks the boundary between Costa Rica and Nicaragua. It is this part of the Border Road which is the object of the present dispute. Some 50.0 km of the Border Road (or 46.2%) was built on pre-existing roads or tracks.[19]

1.12 The fact that much of the Border Road was built on pre-existing rustic roads meant it had a reduced impact on those locations. Around 72% of the area which was used for the Border Road was used for pasture, which had already been cleared of trees and vegetation, long before the Border Road was constructed.[20] Therefore, the impact of the Border Road on the Costa Rican environment, ecology, soil erosion and sediment production along nearly three quarters of its length ranges between low and imperceptible.[21]

D. Circumstances leading to the building of the Border Road

1.13 Several riparian communities inhabiting the area adjacent to the right bank of the San Juan River rely on the River to meet the essential needs of everyday life,[22] as noted by the Court in its 2009 Judgment in the *Navigational Rights* case:

> "In view of the great difficulty of travelling inland, due to the limited inland communications network, that population [the

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19 **Vol 2 Annex No 3**, Allan Astorga G. and Andreas Mende, *Route 1856: Analysis of the Change in Land use Based on Satellite Images Before and After the Construction of the Border Road*, August 2013, p. 6.

20 **Appendix A**, Professor Colin Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, para. 5.9.

21 **Vol 2, Annex No 3**, Allan Astorga G. and Andreas Mende, *Route 1856: Analysis of the Change in Land use Based on Satellite Images Before and After the Construction of the Border Road*, August 2013, p. 27.

22 See Chapter 2, para. 2.4.

> inhabitants of the Costa Rican bank] commonly used and still uses the river for travel for the purpose of meeting the essential needs of everyday life which require expeditious transportation, such as transport to and from school or for medical care."[23]

1.14 Costa Rican public officials have also provided essential health and community services to the riparian communities by navigating on the San Juan, in order to meet the necessities of daily life.[24] Furthermore, a number of Costa Rican police posts are located along the right bank of the San Juan River.[25] Costa Rica's right of navigation for purposes of commerce, and by public officials for the provision of essential health and community services to the riparian community, was confirmed by the Court in its 2009 Judgment in the *Navigational Rights* case.[26]

1.15 However, in the months before Emergency Decree 36440-MP[27] was issued in February 2011, Nicaragua:

(a) obstructed navigation on the San Juan by Costa Rican riparians and public service officials, thereby preventing communication with these remote communities to meet the necessities of everyday life;[28]

(b) occupied and claimed sovereignty over part of Costa Rica's territory in Isla Portillos;[29]

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23 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 246, para. 78.

24 See *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 248, para. 84.

25 See Chapter 2, para. 2.20.

26 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 270, para. 156(1)(g).

27 NM, Annex 11.

28 See Chapter 2, paras. 2.5-2.9.

(c) asserted rights of navigation on the Colorado River, a river running entirely within Costa Rican territory;[30] and

(d) in the context of all of the above, increased the presence of its soldiers along the San Juan River.[31]

As a result of this conduct of Nicaragua, there was at the time, as assessed by Costa Rica, a real risk that if Nicaragua provoked a military confrontation, Costa Rica would have been unable to reach its remote communities to ensure the evacuation and safety of its inhabitants, and unable to protect its territorial integrity through the mobilization of its police.

1.16 Costa Rica has responded to Nicaragua's conduct in a peaceful manner. In response to Nicaragua's occupation of Isla Portillos, Costa Rica commenced proceedings in the *Certain Activities carried out by Nicaragua in the Border Area* (*Certain Activities* case) in November 2010.[32] In response to the pressing need to improve access to its border, Costa Rica took actions within its own territory, in compliance with domestic and international law. Initially, existing dirt tracks were improved and new tracks made, in accordance with a request made by the Costa Rican Minister of Public Security in December 2010.[33] Subsequently, with the need to establish a road along the whole border in mind, Executive Decree 36440-

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29 See Chapter 2, paras. 2.10-2.14.

30 See Chapter 2, paras. 2.15-2.19.

31 See Chapter 2, para. 2.16.

32 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, Application Instituting Proceedings, 18 November 2010.

33 See Chapter 2, para. 2.22.

MP was passed in February 2011, providing the legal framework for the works.[34] Costa Rica also informed the Secretary General of the United Nations of the reasons which prompted construction of the Road.[35] The background facts leading to the construction of the Road are discussed in greater detail in Chapter 2 of this Counter-Memorial.

1.17 By contrast to Nicaragua's silence in response to Costa Rica's repeated written requests for information regarding Nicaragua's activities on the San Juan River and in the border area,[36] Costa Rica formally communicated with Nicaragua through official channels, promptly and in good faith, concerning the road infrastructure works on Costa Rican territory, despite the fact that Nicaragua had taken military actions and made threats to Costa Rica's sovereignty and territorial integrity, and to the welfare and safety of its inhabitants.

1.18 After having learned from the Nicaraguan press that high Government officials in Nicaragua had voiced their concern about the construction of the Border Road, on 29 November 2011 Costa Rica invited Nicaragua, "in the spirit of a good neighbour policy and environmental protection", to detail its concerns to Costa Rica by providing "serious and objective scientific information" in support of its allegations.[37] Thus, Costa Rica took the initiative to promptly enter into a cooperative dialogue with Nicaragua, although Nicaragua had not made any formal request or

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[34] See Chapter 2, para. 2.27.

[35] **Vol 3, Annex No 40,** Note from the Minister of Foreign Affairs and Worship of Costa Rica to the Secretary General of the United Nations, Ref: DM-AM-633-11, 14 December 2011.

[36] See for example *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, paras 1.9, 3.70-77.

[37] **Vol 3, Annex No 39,** Note from the Minister of Foreign Affairs and Worship of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Ref: DM-AM-601-11, 29 November 2011.

complaint to Costa Rica at that time. As it transpired, that same day Nicaragua wrote to Costa Rica expressing its unfounded belief that the road infrastructure works would cause harm to Nicaraguan territory, and demanded "the immediate suspension of these projects until their environmental impact can be assessed".[38]

1.19 Contrary to Nicaragua's contention in its Memorial,[39] a completely unfounded accusation by a neighbouring State that infrastructure activities will meet the required threshold of risk of significant transboundary harm does not trigger the obligation for the State in question to undertake a transboundary EIA. Costa Rica responded appropriately to Nicaragua's concern, by offering to enter into a dialogue with Nicaragua in good faith to address its concerns. This was not – as Nicaragua has contended[40] – an attempt to shift the burden of proof to Nicaragua regarding a determination of whether the works presented a risk of significant transboundary harm.

1.20 On 10 December 2011, the dialogue between the two States continued when Nicaragua responded to Costa Rica's note, not by setting out well-founded concerns, but by presenting the groundless allegation that Costa Rica's works would have "irreversible and transcendental ecological and environmental consequences", and proceeding to list eight unsubstantiated and highly embellished so-called "consequences".[41]

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38 **NM, Annex 14**, Note from the Minister of Foreign Affairs of Nicaragua to the Minister of Foreign Affairs of Costa Rica, Reference MRE/DVM/AJST/500/11/11, Managua, 29 November 2011.

39 NM, paras. 2.29 and 2.30.

40 NM, para. 2.30.

41 **NM, Annex 16**, Note from the Minister of Foreign Affairs of Nicaragua, to the Minister of Foreign Affairs of Costa Rica, Reference MRE/DVS/VJW/0685/12/11, Managua, 10 December 2011,

Nicaragua persisted in contending that its unjustified allegation of potential transboundary harm was sufficient to trigger the requirement for Costa Rica to undertake an EIA, and it demanded that Costa Rica cease its infrastructure works until Nicaragua "has had the chance to receive and analyze the [EIA] on the project."[42] Rather than engaging in constructive dialogue with Costa Rica, Nicaragua thus sought to exercise a veto over Costa Rica's activities on undisputed Costa Rican territory.

1.21 On 20 December 2011 Costa Rica responded to Nicaragua's notes of 29 November and 10 December, noting that the so-called "consequences" outlined by Nicaragua in its note of 10 December 2011 were unsubstantiated, and that if Nicaragua could provide Costa Rica with any demonstrated concerns of potential harm, Costa Rica would be well-placed to address them.[43] More specifically, Costa Rica requested from Nicaragua any existing studies on the San Juan River, as well as "information relating to historical records on turbidity in its waters, chemical composition, historical sediment load, and all scientific data pertinent to the assessment of the river's condition, so as to detect any possible affectations."[44] Costa Rica thus sought to address Nicaragua's allegations in a rational, cooperative manner.

1.22 While Costa Rica reiterated through this Note its invitation for Nicaragua to substantiate its concerns regarding potential harm to its

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[42] **NM, Annex 16**, Note from the Minister of Foreign Affairs of Nicaragua, to the Minister of Foreign Affairs of Costa Rica, Referece MRE/DVS/VJW/0685/12/11, Managua, 10 December, 2011.

[43] **Vol 3, Annex No 41,** Note from the Viceminister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DVM-AM-286-11, 20 December, 2011.

[44] *Ibid*.

territory, it also highlighted the tendentious nature of Nicaragua's approach in light of Nicaragua's failure to provide Costa Rica with any information regarding several Nicaraguan projects on or near the San Juan River which risked significantly adversely affecting the San Juan River and the quality of its waters, including the Nicaraguan dredging program along the river, the cutting of meanders along the Nicaraguan bank of the San Juan and deviation of the natural riverbed, the construction of the airport at San Juan del Norte, and the Santa Fe Bridge across the San Juan.[45] Nicaragua did not respond to this note, nor did it provide the information requested by Costa Rica.

1.23 In response to Nicaragua's silence regarding Costa Rica's request for data that could substantiate Nicaragua's unfounded claim of damage to the San Juan River, on 26 January 2012 Costa Rica's Deputy Minister of Foreign Affairs wrote again to Nicaragua, requesting once again the aforementioned information.[46] For a second time, Nicaragua failed to respond to Costa Rica's request to substantiate its allegations. Nicaragua also failed to mention this note in its Memorial.

1.24 Since that time, Costa Rica has taken a series of measures designed to lessen the environmental impact of the Border Road (impacts that, insofar as they may be of some significance, are felt solely within Costa Rican territory).[47] Nicaragua on the other hand has extended its claims to Costa

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45 **Vol 3, Annex No 41,** Note from the Viceminister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DVM-AM-286-11, 20 December, 2011.

46 **Vol 3, Annex No 42,** Note from the Minister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DM-AM-045-12, 26 January 2012.

47 See Chapter 2, paras. 2.38-2.41.

Rican territory, specifically the province of Guanacaste,[48] and has contested Costa Rica's well-established and Treaty-based joint sovereignty over the Bay of San Juan del Norte.[49] In these and other respects it has conducted what amounts to a campaign of provocation (and in this respect reference is made to paragraphs 44 to 47 of the Court's provisional measures order of 22 November 2013 in the *Certain Activities* case).

E. The Court's jurisdiction

1.25 In its Memorial, Nicaragua submits that '[i]n accordance with the provisions of Article 36, paragraph 1, of the Statute, jurisdiction exists by virtue of Article XXXI of the American Treaty on Pacific Settlement signed in Bogotá on 30 April 1948 (***Pact of Bogotá***)' and that "[i]n accordance with the provisions of Article 36, paragraph 2, of the Statute, jurisdiction also exists by virtue of the operation of the Declaration of the Applicant State dated 24 September 1929 and the Declaration of Costa Rica dated 20 February 1973".[50]

1.26 In its Memorial, Nicaragua states:

> "In accordance with the provisions of Article 36, paragraph 1, of the Statute, jurisdiction exists by virtue of Article XXXI of the American Treaty on Pacific Settlement signed in Bogotá on 30 April 1948 (Pact of Bogotá). Both the Republic of Nicaragua and the Republic of Costa Rica are parties to the Pact of Bogotá, the former without any pertinent reservation, and the latter with no reservations. In accordance with the provisions of Article 36, paragraph 2, of the Statute, jurisdiction also exists by virtue of the operation of the

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48 See Chapter 2, paras. 2.24 and 2.27.

49 See Chapter 2, paras. 2.18-2.19.

50 NM, para. 1.4.

> Declaration of the Applicant State dated 24 September 1929 and the Declaration of Costa Rica dated 20 February 1973, both Declarations being without pertinent reservations."[51]

Contrary to Nicaragua's assertion, the Court's jurisdiction under Article 36(2) of the Statute and its jurisdiction under the Pact of Bogotá are subject to relevant limitations.

1.27 Article VI of the Pact of Bogotá provides that the procedures under the Pact, including the Judicial Procedure contained in Chapter IV:

> "… may not be applied to matters already settled by arrangement between the parties, or by arbitral award or by decision of an international court, or which are governed by agreements or treaties in force on the date of the conclusion of the present Treaty."[52]

The Pact of Bogotá was concluded on 30 April 1948 and post-dates the 1858 Treaty of Limits and the arbitral awards which interpret and apply it.[53] To the extent that Nicaragua's claims concern matters already settled by the arbitral awards or governed by the 1858 Treaty of Limits, the Court does not have jurisdiction over them under the Pact.

1.28 Nicaragua is seeking an alteration of Costa Rica's perpetual right of free navigation on the San Juan River. Nicaragua claims that Costa Rica is "no more entitled to claim"[54] that right and also requests the Court to adjudge and declare that it be allowed "to take appropriate counter measures

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51 NM, para. 1.4.

52 American Treaty on Pacific Settlement, Bogotá, 30 April 1948, 30 UNTS 84, Art. VI.

53 The Cleveland Award (NM, Vol. II, Annex 6(1)) is dated 22 March 1888 and the five Alexander Awards (NM, Vol. II, Annexes 6(2)-(5)) are dated 30 September 1897, 20 December 1897, 22 March 1898, 26 July 1899 and 10 March 1900.

54 NM, para. 6.36.

including the suspension of Costa Rica's right of navigation in the San Juan de Nicaragua River".[55]

1.29 The extent of Costa Rica's right of navigation was settled by Article VI of the 1858 Treaty of Limits, with it being agreed that Costa Rica was to have a "perpetual" right. That Article provides:

> "The Republic of Nicaragua shall have exclusive *dominium* and *imperium* over the waters of the San Juan river from its origin in the lake to its mouth at the Atlantic Ocean; the Republic of Costa Rica shall however have a perpetual right of free navigation on the said waters between the mouth of the river and a point located three English miles below Castillo Viejo ..."[56]

Nicaragua cannot reopen the matter. As stated by the Court in *Territorial and Maritime Dispute (Nicaragua v. Colombia)*:

> "… the clear purpose of [Article VI of the Pact of Bogotá] was to preclude the possibility of using those procedures, and in particular judicial remedies, in order to reopen such matters as were settled between the parties to the Pact, because they had been the object of an international judicial decision or a treaty."[57]

1.30 As this particular matter has been settled, there is no extant "legal dispute" regarding Costa Rica's navigational rights and to this extent the Court does not have jurisdiction over the matter under Article 36(2) of the

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55 NM, Submissions, para. 3(iii).

56 Treaty of Limits between Costa Rica and Nicaragua (Cañas-Jerez), San José, 15 April 1858, Art. VI, as quoted in *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 236, para. 44.

57 *Territorial and Maritime Dispute (Nicaragua v. Colombia), Preliminary Objections, Judgment, I.C.J. Reports 2007*, p. 858, para. 77.

Statute.[58] But Costa Rica raises no preliminary objection in this regard: it recalls this point only insofar as it may be relevant in circumscribing the issues the Court actually has to decide and may thus contribute to the prompt and expeditious handling of the joined proceedings.

1.31 The Court noted in its Order of 17 April 2013, in which it decided to join the proceedings, that it "does not expect any undue delay in rendering its Judgment in the two cases" as a result of its Order.[59] Costa Rica likewise considers that joinder should not lead to any undue delay, and with this in view, it simply calls on the Court to decide, in the course of the proceedings on the merits of Nicaragua's other claims, the extent of its jurisdiction under Article VI of the Pact of Bogotá.

F. The Structure of this Counter-Memorial

1.32 This Counter-Memorial is filed in accordance with the Court's Order of 23 January 2012 setting the date for submission of Costa Rica's Counter-Memorial as 19 December 2013.

1.33 The Counter-Memorial consists of five further Chapters, as follows: **Chapter 2** addresses in more detail the factual circumstances relevant to the present dispute, including the events which led Costa Rica to undertake the infrastructure works on the Border Road and the status of Emergency Decree 36440-MP under Costa Rican law. In **Chapter 3**, Costa Rica explains that the Road has had no adverse impact on the San Juan River, contrary to Nicaragua's unsupported assertions. In **Chapter 4**, Costa Rica

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[58] See *Territorial and Maritime Dispute (Nicaragua v. Colombia), Preliminary Objections, Judgment, I.C.J. Reports 2007*, pp. 873-874, para. 138.

[59] *Construction of a Road in Costa Rica Along the San Juan River, Joinder of Proceedings, Order, 17 April 2013*, para. 17.

addresses why the fundamental instrument governing the relationship between Costa Rica and Nicaragua, the 1858 Treaty of Limits, has no bearing on the dispute before the Court. That boundary treaty does not regulate the exercise of Costa Rica's sovereignty within its own territory. **Chapter 5** then establishes that the construction of the Road has not breached any conventional or customary international law obligation. Finally, **Chapter 6** addresses why Nicaragua is not entitled to the remedies it seeks.

1.34 Attached to this Counter-Memorial as **Appendix A** is the Expert Report of Professor Colin Thorne of November 2013, together with the following related expert reports.

(a) Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River,* August 2013 (the ***ICE Report***) (**Annex 4**; also submitted as Attachment CR-1 on Nicaragua's Request for Provisional Measures);[60]

(b) University of Costa Rica Centre for Research in Sustainable Development, Department of Civil Engineering, *Report on Systematic Field monitoring of Erosion and Sediment Yield along Route 1856*, September 2013 (the ***UCR Report***) (**Annex 1**; also submitted as Attachment CR-2 on Nicaragua's Request for Provisional Measures); and

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[60] **Vol 2, Annex No 4**, Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River*, August 2013, p. 2.

(c) Allan Astorga G. and Andreas Mende, *Route 1856: analysis of the change in land use based on satellite images before and after the construction of the border road*, August 2013 (the ***Land Use Change Report***) (**Annex 3**; also submitted as Attachment CR-4 on Nicaragua's Request for Provisional Measures);

(d) Andreas Mende and Allan Astorga G., *Inventory of Slopes and Water Courses related to the Border Road No 1856 between Mojón II and Delta Costa Rica*, October 2013 (the ***Inventory of Slopes and Water Courses***) (**Annex 6**); and

(e) Andreas Mende, with Allan Astorga G. and Olivier Chassot, *Border Road No 1856 – Evaluation of the 54 Sites of Purported Direct Sediment Delivery mentioned by Ph.D. Mathias Kondolf*, September 2013 (the ***54 Points Report***) (**Annex 5**).

In addition, a team of experts from the Tropical Science Centre (CCT, in its Spanish acronym) have carried out an Environmental Diagnostic Assessment, pursuant to Costa Rican administrative regulations. This Environmental Diagnostic Assessment (the ***CCT Report***) is submitted as **Annex 10** to this Counter-Memorial.

A list of the annexes is provided at the end of this volume.

Chapter 2

Circumstances leading to the Construction of the Road

A. Introduction and background

2.1 The claims made by Nicaragua against Costa Rica in the present proceedings arise against the background of various attempts made by Nicaragua to challenge the long-settled boundary regime between the two States, established by the 1858 Treaty of Limits and related instruments. In spite of the Court's Judgment in the case concerning *Dispute Regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*, rendered on 13 July 2009, Nicaragua has obstructed Costa Rica's exercise of its right of navigation on the San Juan River. Over a 16-month period, starting with the occupation of the Costa Rican territory in the northern sector of Isla Portillos, Nicaragua embarked on a course of hostile conduct against Costa Rica, which prompted Costa Rica to take urgent measures, entirely on its own undisputed territory, to safeguard its sovereignty and territorial integrity, and to protect the welfare and safety of its inhabitants. These measures included the issue of an Emergency Decree and the undertaking of urgent road infrastructure works in the border area. These peaceful measures were taken in full compliance with international and Costa Rican law.

2.2 This Chapter first describes the context under which the Border Road was constructed, including the reasons motivating its construction, which included the need to allow Costa Rican police direct and expeditious access to the border area, in order to provide the local population with essential services (see **Section B** below). The Road was constructed pursuant to Costa Rica's Emergency Decree: that Decree and its implementation are discussed in **Section C** below, together with the remediation works which have been carried out and which are continuing.

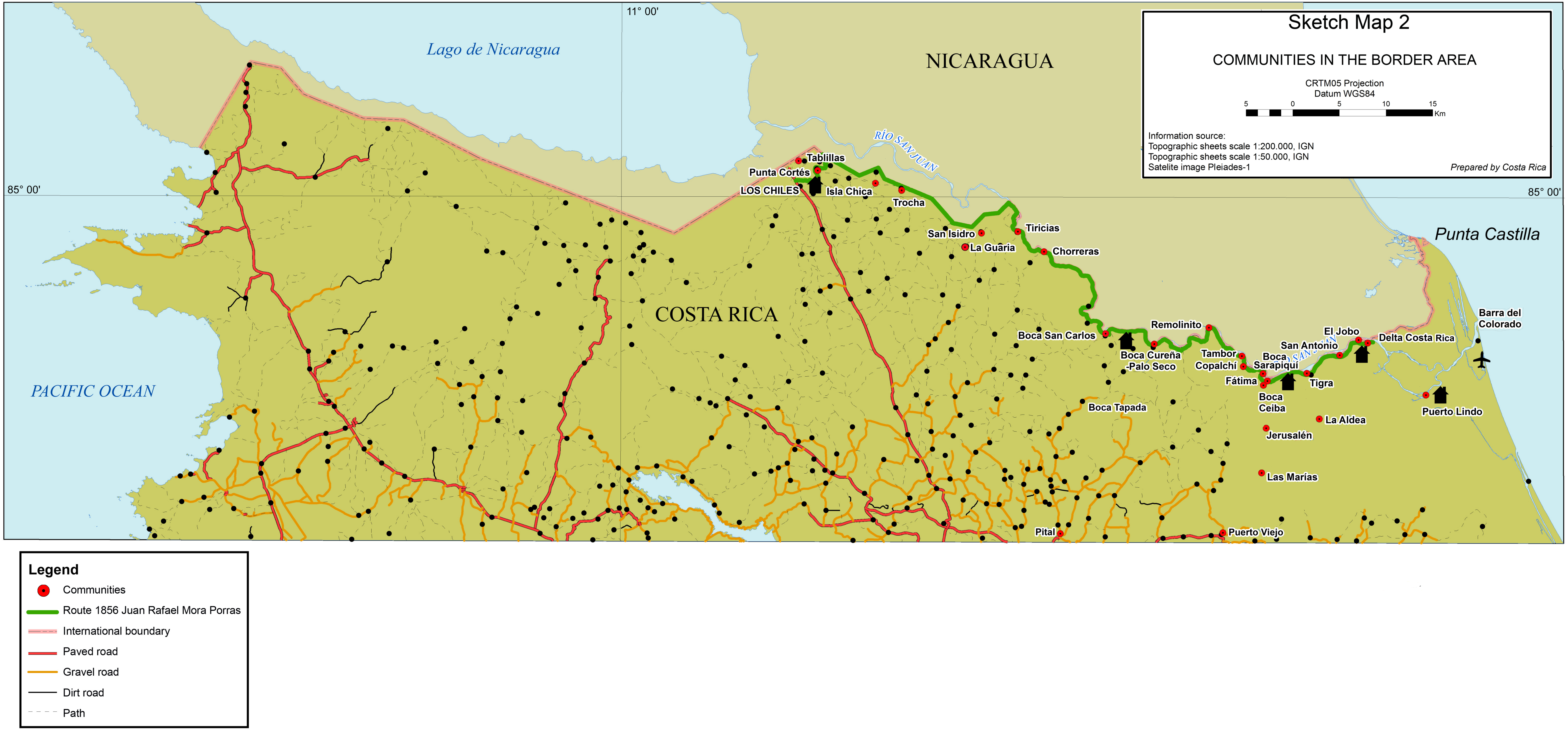
B. Nicaragua's conduct and further threats to Costa Rica

2.3 Four principal incidents constitute essential background to the issuance of the Emergency Decree. They explain Costa Rica's reasonable perception of the urgent need for road infrastructure works in the border area. They were: (1) Nicaragua's obstruction of the exercise of Costa Rica's right to navigate the San Juan River; (2) Nicaragua's illegal occupation of Costa Rican territory in the northern sector of Isla Portillos; (3) Nicaragua's extraordinary claim to navigate on the Colorado River; and (4) Nicaragua's increased military presence in the border area, creating a legitimate fear of further incidents. An additional element was Costa Rica's need to provide land access to its police posts along the border. Since these events, Nicaragua has embarked on further unsettling and provocative behaviour.

(1) Nicaragua's obstruction of the right to navigate the San Juan River

2.4 Nicaragua's conduct must be viewed in the geographical context of Costa Rica's border area, which according to a survey conducted in 2012 by Costa Rica's Ministry of Planning is home to some 1,900 people living in remote communities between Delta Colorado and Marker II near Tiricias.[61] (See **Sketch Map 2**) These individuals have historically relied on the San Juan River as the means of communication in the border area, due to the

[61] Information provided by Costa Rica's Ministry of Planning and National Development, based on data provided by the Ministry of Housing and Human Settlements and the Health Areas of the Ministry of Public Health. There are approximately 4,000 inhabitants residing in the whole area serviced by the Border Road, i.e. between the town of Los Chiles and Delta Colorado.


Sketch Map 2
COMMUNITIES IN THE BORDER AREA
CRTM05 Projection
Datum WGS84
5 0 5 10 15
Km
Information source:
Topographic sheets scale 1:200.000, IGN
Topographic sheets scale 1:50.000, IGN
Satelite image Pleiades-1
Prepared by Costa Rica
11° 00'
85° 00'
85° 00'
Lago de Nicaragua
NICARAGUA
COSTA RICA
PACIFIC OCEAN
Punta Castilla
RÍO SAN JUAN
Tablillas
Punta Cortés
LOS CHILES
Isla Chica
Trocha
Tiricias
San Isidro
La Guária
Chorreras
Remolinito
Boca San Carlos
Boca Cureña
-Palo Seco
Tambor
Copalchí
Fátima
Boca
Sarapiquí
San Antonio
El Jobo
Delta Costa Rica
Barra del
Colorado
Tigra
Boca
Ceiba
Boca Tapada
Puerto Lindo
La Aldea
Jerusalén
Las Marías
Pital
Puerto Viejo
Legend
Communities
Route 1856 Juan Rafael Mora Porras
International boundary
Paved road
Gravel road
Dirt road
Path

lack of inland roads.[62] As Costa Rica noted in *Dispute regarding Navigational and Related Rights*, there were no proper roads to provide access to most of the hamlets and small villages along the Costa Rican bank of the San Juan River.[63] Nicaragua itself acknowledged in 2008 that "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".[64] Due to the lack of a reliable road network in the border area, and in light of the obstruction by Nicaragua of the exercise of Costa Rica's right to navigate the San Juan River, there existed no safe and efficient route of evacuation, and no means by which to provide the local population with essential services in the areas of security, health, and education.

2.5 On 24 September 2009, only a few months after the Judgment of the Court in the *Dispute regarding Navigational and Related Rights* case was handed down on 13 July 2009, the Nicaraguan Government issued an Executive Decree entitled "Creation of the Inter-institutional Commission to Develop and Implement the Regulations Regarding Navigation on the San Juan River, specifically where the International Court of Justice Grants

62 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*, Memorial of Costa Rica, paras. 2.05, 2.06, and 4.53.

63 CR 2009/2, p. 16, para. 7 (Brenes) (verbatim record of 2 March 2009 in *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*).

64 *Certain Activities carried out by Nicaragua in the Border Area*, NCM, Vol. II, Annex 12, Technical Opinion, Environmental Impact Study Project, Improvement of Navigation on the San Juan de Nicaragua River, November 2008, p. 263 (emphasis added).

Limited Navigation Rights to the Republic of Costa Rica", which contained a set of "Regulations Regarding Navigation on the San Juan River".[65]

2.6 As is indicated by the title of the document and from a summary review of it, Decree 79-2009 is contrary to the Court's Judgment of 13 July 2009. It regulates navigation on the San Juan River by Costa Ricans only. It will be recalled that one of the conditions for regulation by Nicaragua of navigation on the San Juan River is that such regulation "must not be discriminatory",[66] meaning that the regulation of navigation along the San Juan River must apply equally to both Nicaraguans and Costa Ricans. Decree 79-2009, however, discriminates against Costa Ricans.

2.7 Similarly, the Court held that a regulation "must only subject the activity to certain rules without rendering impossible or substantially impeding the exercise of the right of navigation";[67] that "it must be consistent with the terms of the Treaty [of Limits]";[68] that "it must have a legitimate purpose";[69] and that "it must not be unreasonable".[70] Decree 79-2009 imposes numerous requirements for navigation that are unreasonable and inconsistent with the 1858 Treaty of Limits, and which in practice

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65 **Vol 3, Annex No 26**, Nicaragua, Executive Decree No 79-2009 of 24 September 2009, 'Creation of the Inter-institutional Commission to Develop and Implement the Regulations Regarding Navigation on the San Juan River, specifically where the International Court of Justice Grants Limited Navigation Rights to the Republic of Costa Rica', published in The Gazette of 1 October 2009.

66 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 249, para. 87(4).

66 CR 2011/2, p. 9, para. 7 (Argüello).

67 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 249, para. 87(1).

68 *Ibid*, para. 87(2).

69 *Ibid*, para. 87(3).

70 *Ibid*, para. 87(5).

rendered Costa Rican navigation on the San Juan River subject to the unregulated discretion of local military personnel.

2.8 Costa Rica protested this Decree by diplomatic note of 20 November 2009; an annex to the note analysed in some detail why the Decree was contrary to the Court's Judgment.[71] Nicaragua responded nearly three months later, summarily dismissing Costa Rica's arguments without providing any explanation.[72] In light of this unsatisfactory response, Costa Rica again wrote to Nicaragua, reiterating its opposition to the aforementioned Decree, and proposing a formal mechanism for dialogue having due regard to the difference in interpretation of the Court's Judgment of 13 July 2009 by both countries.[73] Nicaragua never responded to Costa Rica's note.

2.9 In practice, Nicaragua has obstructed Costa Rican navigation on the San Juan. For example, the only teacher at the "El Jobo" Primary School on Isla Calero was prevented from navigating the San Juan River in order to reach the school, and consequently the school had to be closed.[74] Costa Rican journalists were also prevented from navigating on the River.[75]

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71 **Vol 3, Annex No 34**, Note from the Minister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DM-AM-816-09, 20 November 2009.

72 **Vol 3, Annex No 35**, Note from the Minister of Foreign Affairs of Nicaragua to the Minister of Foreign Affairs of Costa Rica, Reference MRE/DM-AJST/297/3/2010, 25 March 2010.

73 **Vol 3, Annex No 36**, Note from the Minister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DM-AM-327-10, 22 April 2010.

74 *Certain Activities carried out by Nicaragua in the Border Area*, CRM, Vol. I p. 292, para. 6.58.

75 **Vol 3, Annex No 69**, La Nación (Costa Rica), 'Nicaraguan immigration denies entry to journalists through San Juan River', 22 October 2010, available at http://wfnode01.nacion.com/2010-10-22/ElPais/UltimaHora/ElPais2564695.aspx?Page=3 .

(2) Nicaragua's illegal occupation of Costa Rican territory

2.10 Costa Rica's Memorial in the *Certain Activities* case details the events related to Nicaragua's military occupation of the Costa Rican territory known as Finca Aragón, located in the northern sector of Isla Portillos ('the Area'), and registered under the Ramsar Convention by Costa Rica as a wetland of international importance. It is nevertheless necessary to recall these events briefly, as they constitute the relevant background to the present proceedings.

2.11 On 20 October 2010, Costa Rican officials observed during an overflight that Nicaraguan personnel had unlawfully entered the Area, and were unlawfully depositing on the Area sediment extracted from the San Juan River as part of Nicaragua's dredging programme. On 21 October 2010, Costa Rica formally protested the presence of Nicaraguan personnel on its territory, and their activities.[76] Subsequently Nicaragua withdrew its personnel and removed its dredging equipment. On 22 October 2010, Costa Rican police and civilian personnel entered Finca Aragón and discovered that Nicaraguan personnel had felled a considerable portion of primary forest.[77]

2.12 On 1 November 2010, Costa Rican officials observed during an overflight that Nicaraguan military personnel had re-entered the Area and had set up a military camp in close proximity to where they had previously

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[76] *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, para. 1.7, and Vol. III, Annex 47, Note from the Acting Minister of Foreign Affairs and Worship of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DM-412-10, 21 October 2010.

[77] *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, paras. 3.10-3.11.

deposited sediment from the San Juan River. The presence of Nicaraguan military personnel in the Area posed an immediate threat to the welfare and safety of the Costa Rican police, as is evident from a photo reproduced below of Nicaraguan soldiers in the Nicaraguan military camp aiming their weapons at the Costa Rican civilian aircraft flying overhead.

Figure 2.1: Photograph of Nicaraguan soldiers pointing guns at the Costa Rican aircraft[78]

2.13 Shortly after these events, Nicaragua began constructing an artificial canal in the Area ('the *caño*'), in an attempt to deviate the San Juan River across Costa Rican territory and into Los Portillos Lagoon (known in English as 'Harbor Head Lagoon'), and thereby to modify the settled border between Costa Rica and Nicaragua. As a result of this situation, on

[78] This photograph was produced in *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, Figure 3.1, p. 76.

18 November 2010, Costa Rica initiated proceedings against Nicaragua before the Court in the *Certain Activities* case[79] and made a request for the indication of provisional measures.[80] The Court issued an Order for Provisional Measures on 8 March 2011,[81] which it recently had cause to reaffirm when it issued a further Order for New Provisional Measures on 22 November 2013.[82]

2.14 Following the close of the oral hearings on provisional measures in 2011, Nicaragua continued to station military troops in the Area, though it claimed – incorrectly – that "no Nicaraguan military or other governmental personnel have been present in the disputed area since December 2010."[83] The presence of Nicaraguan military personnel in the Area on 19 January 2011 was documented by photographs taken by Costa Rican police during a flyover of the Area and submitted to the Court.[84] Nicaragua has since acknowledged that its military camp remained on Costa Rican territory,

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79 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, Application instituting proceedings, 18 November 2010.

80 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, Request for the Indication of Provisional Measures, 18 November 2010.

81 *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua), Application for Provisional Measures, Order of 8 March 2011, I.C.J. Reports 2011,* p. 6.

82 *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua), Application for Provisional Measures, Order of 22 November 2013,* para. 59(1).

83 NM, para. 2.17.

84 Comments by Costa Rica on the Reply of Nicaragua to the questions put by Judges Simma, Bennouna and Greenwood at the end of the hearing on provisional measures requested by Costa Rica in *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, Reference ECRPB017-11, 20 January 2011. See also *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, para. 3.53.

even after Nicaragua told the Court that it had been removed.[85] Furthermore, Nicaragua has persisted in its unfounded claim of sovereignty over the Area by publishing official cartography which has been modified to support the arguments it presented before the Court on the location of the border.[86] Costa Rica protested this map.[87] Nicaragua never responded to Costa Rica's protest.

(3) Nicaragua's threats to the Colorado River and increased presence of military personnel in the border area

2.15 On 13 November 2010, the Nicaraguan press reported that Nicaragua's President Daniel Ortega had "announced that Nicaragua will request before the International Court of Justice (ICJ) navigation through the Colorado River under the same terms and conditions that Costa Rica has to navigate San Juan de Nicaragua River, whilst the cleaning and dredging of this affluent are being concluded to recover its water level".[88] The

85 See CR 2013/25, p. 28, para. 41 (Reichler); and CR 2013/27, p. 19, para. 42 (Reichler). In addition, Nicaragua admitted that it had established and maintained a military camp on the beach of Isla Portillos (see CR 2013/25, p.29, para. 44 (Reichler); and CR 2013/27, p. 17, para. 36 (Reichler)). In its Order of 22 November 2013, the Court confirmed that this camp was in the Disputed Territory and ordered Nicaragua to remove it: *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua), Application for Provisional Measures, Order of 22 November 2013*, paras. 55 and 59(2)(C).

86 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, paras. 2.54 and 3.55. Nicaragua showed the map to the Court during the hearing on provisional measures in October 2013: see Nicaragua Judges Folder, 17 October 2013, Tab 29 (CAG 2.1).

87 **Vol 3, Annex No 38**, Note from Minister Rene Castro Salazar to Minister Samuel Santos López, Reference DM-059-11, 2 February 2011.

88 **Vol 3, Annex No 71**, El 19 (Nicaragua), 'Nicaragua will request before the ICJ Navigation through Río Colorado', 13 November 2010, available at http://www.el19digital.com/index.php?option=com_content&view=article&id=18149:nicaragua-pedira-ante-cij-navegacion-por-rio-colorado&catid=23:nacionales&Itemid=12.

Colorado River runs entirely within Costa Rican territory.[89] Nicaragua has no right of navigation on the Colorado River.

2.16 President Ortega's threat to claim navigational rights on the Colorado River was accompanied by an increased presence of Nicaraguan soldiers along the San Juan River,[90] particularly in the lower San Juan River, i.e. the stretch between the Delta of the Colorado River (also known as 'Delta Costa Rica') and the outlet of the San Juan in the Caribbean. In light of Nicaragua's aggressive rhetoric and its actions, including the convergence of troops in the border area, Costa Rica's Minister of Public Security considered that there was a real and present risk that the Nicaraguan Government would aggravate the dispute concerning navigation on the Colorado River by having Nicaraguan military personnel enter the Colorado River by force.[91]

2.17 On 11 January 2011 during the oral hearings on provisional measures in the *Certain Activities* case, Nicaragua's Agent, Mr. Argüello Gómez, repeated Nicaragua's threat to claim non-existent navigational rights on the Colorado River in the following terms:

> "Furthermore, he [President Ortega] indicated that Nicaragua would also claim the right to navigate out to the Caribbean Sea via the branch of the Colorado river at least until Nicaragua was able to

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89 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)*, CRM, para. 1.3.

90 **Vol 3, Annex No 70**, La Nación (Costa Rica), 'Nicaragua Reinforces Troops at the Border', 24 October 2010, available at http://www.nacion.com/sucesos/Nicaragua-refuerza-tropas-frontera_0_1154884554.html.

91 **Vol 3, Annex No 17**, Costa Rica, Statement given under oath by Mr. José María Tijerino, Minister of Public Security of Costa Rica, before the Permanent Special Commission for the Control of Public Revenue and Expenses, Minutes of Extraordinary Session No 50, 29 January 2013.

clean the San Juan river from the sedimentation provoked by the Costa Rican deforestation of its territory and recover the possibility of navigating it out to sea."[92]

2.18 The Agent of Nicaragua also announced in the same oral hearings that Nicaragua disputes the common ownership of the bays of Salinas in the Pacific, and San Juan del Norte on the Caribbean:

> "Other very important issues stemming from the 1858 Treaty are still in dispute between the Parties and involve, for example, the situations of the Bays of San Juan and Salinas."[93]

2.19 Nicaragua's threats to contest Costa Rica's shared sovereignty over the Bay of San Juan del Norte, and new claim to non-existent navigational rights on the Colorado River, both materialized as counter-claims in Nicaragua's Counter-Memorial in the *Certain Activities* case.[94] The Court held these claims to be inadmissible.[95] However, Nicaragua has not publicly withdrawn these claims. Until they are withdrawn, Costa Rica must continue to treat these claims as threats to its sovereignty and territorial integrity.

(4) The need for Costa Rica to have land access to its police posts

2.20 A number of Costa Rican police posts are situated along the right bank of the San Juan River. Prior to the road works being carried out, there was no efficient and reliable means of communication among these police

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92 CR 2011/2, p. 9, para 7 (Argüello).

93 CR 2011/4, p. 35, para 6 (Argüello).

94 NM, paras. 9.34-9.45.

95 *Certain Activities carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua)* and *Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica)*, Counter-Claims, Order of 18 April 2013, para. 38.

posts. This lack of access limited the services that Costa Rica could provide to the local population in the border area.

2.21 The only means for accessing some of these police posts was by Costa Rican rivers, such as the Colorado and the Sarapiquí. The only police post that could be accessed by land was the post at Boca San Carlos. The post at La Cureña had to be closed due to the impossibility of accessing it by land.[96] The police post at Delta Colorado could only be accessed either by travelling upstream through the Colorado and Caño Bravo rivers by boat from Barra del Colorado (which in turn can only be accessed by plane or by sea), or by boat travelling through smaller canals from the village of Puerto Lindo and then following the Colorado or Caño Bravo rivers. **Sketch Map 3** illustrates how these police posts could only be accessed through Costa Rican rivers prior to the construction of the Border Road.

2.22 As noted in paragraph 2.16 above, in late 2010, Nicaragua was increasing its military presence along the San Juan River, particularly in the area of the lower San Juan River.[97] In the circumstances, Costa Rica had a very real and plausible concern that the situation would further escalate into an armed conflict. On 1 December 2010 the Costa Rican Minister of Public Security, Mr José Maria Tijerino, informed the Costa Rican Minister of Public Works, Mr Francisco Jiménez, that the National Security Council had studied land access in the northern area of the country, especially close

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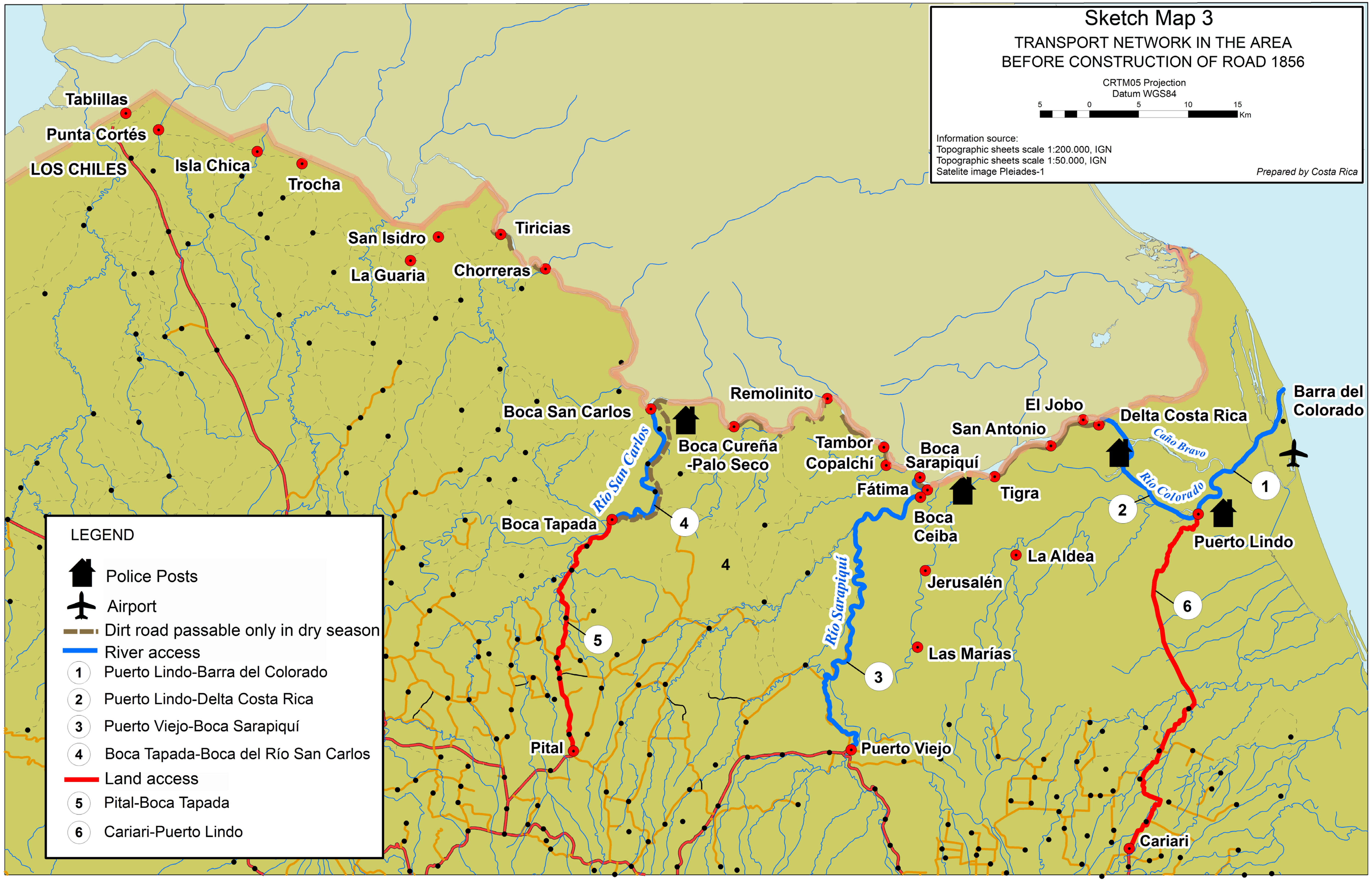
96 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*, Reply of Costa Rica, para. 3.94(i).

97 **Vol 3, Annex No 70**, La Nación (Costa Rica), 'Nicaragua Reinforces Troops at the Border', 24 October 2010, available at http://www.nacion.com/sucesos/Nicaragua-refuerza-tropas-frontera_0_1154884554.html .



Sketch Map 3
TRANSPORT NETWORK IN THE AREA
BEFORE CONSTRUCTION OF ROAD 1856
CRTM05 Projection
Datum WGS84
5 0 5 10 15
Km
Information source:
Topographic sheets scale 1:200.000, IGN
Topographic sheets scale 1:50.000, IGN
Satelite image Pleiades-1
Prepared by Costa Rica
Tablillas
Punta Cortés
LOS CHILES
Isla Chica
Trocha
San Isidro
La Guaria
Tiricias
Chorreras
Boca San Carlos
Remolinito
Boca Cureña
-Palo Seco
Tambor
Copalchí
Boca
Sarapiquí
Fátima
Boca
Ceiba
San Antonio
El Jobo
Delta Costa Rica
Barra del
Colorado
Tigra
Puerto Lindo
La Aldea
Jerusalén
Las Marías
Boca Tapada
Pital
Puerto Viejo
Cariari
Río San Carlos
Río Sarapiquí
Río Colorado
Caño Bravo
LEGEND
Police Posts
Airport
Dirt road passable only in dry season
River access
1 Puerto Lindo-Barra del Colorado
2 Puerto Lindo-Delta Costa Rica
3 Puerto Viejo-Boca Sarapiquí
4 Boca Tapada-Boca del Río San Carlos
Land access
5 Pital-Boca Tapada
6 Cariari-Puerto Lindo

to the border with Nicaragua, and had found that the following areas had very limited and unreliable police access:

(a) Delta Costa Rica and Boca Río Sarapiquí in the Sarapiquí Canton;

(b) Puerto Lindo in the Pococí Canton; and

(c) La Trocha in Los Chiles Canton.[98]

The National Security Council met on 24 November 2010 to analyse the threats posed by Nicaragua's actions on Isla Portillos and had requested that the Ministers carry out the actions necessary to ensure access to the area.[99] Minister Tijerino's note concluded with the following request: "For police logistics reasons these access routes must be in acceptable condition for vehicle transport; consequently, I respectfully request that you repair these routes."[100] In accordance with this request, in December 2010 work began to improve a dirt path between Delta Colorado and the town of Fatima, to allow direct access by land from the town of Puerto Viejo de Sarapiquí to the police post at Delta Colorado. This work was subsequently extended to the community of Boca Sarapiquí (Trinidad), to allow access to the police post there.

2.23 Costa Rica's perception of a real risk that further hostile action would be taken by Nicaragua in the border area is further evidenced by a

98 **Vol 3, Annex No 37**, Note from the Minister of Public Security of Costa Rica to the Minister of Public Works and Transportation of Costa Rica, Reference 2278-2010, 1 December 2010.

99 **Vol 3, Annex No 15**, Government of Costa Rica, National Security Council Ordinary Session No 3 of 24 November 2010.

100 **Vol 3, Annex No 37**, Note from the Minister of Public Security of Costa Rica to the Minister of Public Works and Transportation of Costa Rica, Reference 2278-2010, 1 December 2010.

sworn statement made by Minister Tijerino before the Costa Rican Congress on 29 January 2013:

> "... it is well known that our northern border is one of the less developed regions of the country. Terrestrial communications in the Northern Zone for decades had been a pending matter for all governments. Probably the right of free navigation on the San Juan River, which assists Costa Rica under international treaties, had made the need for road development in the region less pressing.
>
> From the moment when Nicaragua started to ignore the right of free navigation, and to submit our fellow nationals who reside in the area to all sorts of indignities, reaching the extreme of preventing by force of arms any Costa Rican from navigating the waters of the river, it became urgent to build a road along the entire border, which would enable not only the exercise of sovereignty by the presence of the security forces in this area of the country threatened by a regime determined to ignore the existing borders for more than half a century, but also the everyday life, in all its aspects, of the Costa Rican inhabitants of the San Juan River.
>
> The military invasion of a portion of the country and the threat that it could extend along the northern border, made imperative the government's decision to first, improve the existing roads to allow the reinforcement and supply of our police posts; the expeditious evacuation of the residents, if necessary, due to an escalation of the conflict; medical assistance to those eventually wounded; and an orderly retreat against the onslaught of the invader.
>
> Those are the circumstances under which my office issued note 2278-2012-DM on 1 December 2010, in which I ask the Minister of Public Works and Transport responsible at the time, Francisco Jiménez Reyes, his good offices for the repair of the roads leading to Delta Costa Rica and Boca del Rio Sarapiquí in the canton of Sarapiquí, to

Puerto Lindo in Pococí, and the population of La Trocha in the canton of Los Chiles …"[101]

(5) Further provocative and unsettling behaviour by Nicaragua

2.24 Since the events described above, Nicaragua has continued to behave provocatively. Nicaragua has suggested that it may make a claim of sovereignty over the province of Guanacaste, a territory comprising over 11,000 km^2 inhabited by more than 325,000 Costa Ricans, which it had previously recognized as Costa Rican.[102] President Ortega made unsettling remarks in this respect on 6 April 2011, at the inauguration of the 2011 academic year at the Universidad Nacional Autónoma de Nicaragua (UNAN) in León, Nicaragua.[103] This exacerbated Costa Rica's concern that further conflicts over territorial claims could arise. On 13 August 2013 during a celebration of Nicaragua's Naval Force, President Ortega again suggested that Nicaragua may take action "to recover an immense territory" in the Costa Rican province of Guanacaste amounting to thousands of square kilometres, which he compared to the mere "2.8 square kilometres"

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101 **Vol 3, Annex No 17**, Costa Rica, Statement given under oath by Mr. José María Tijerino, Minister of Public Security of Costa Rica, before the Permanent Special Commission for the Control of Public Revenue and Expenses, Minutes of Extraordinary Session N° 50, 29 January 2013.

102 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*, Counter-Memorial of Nicaragua, paras. 9, 1.2.6, 1.2.49, 1.3.8, 1.3.23, 4.1.5 (a), and 4.1.33; *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua)*, Rejoinder of Nicaragua, paras. 1.6, 2.19, 2.82, 2.103, 2.160, 3.5, 5.4, Appendix paras xxi, xlvii and xlviii.

103 **Vol 3, Annex No 16**, Nicaragua, 'Inaugural Lesson of the Academic Year 2011, 6 April 2011', transcript of public speech delivered by President Ortega, available at http://www.presidencia.gob.ni/index.php?option=com_content&view=article&id=358:leccion-inaugural-del-ano-academico-2011&catid=84:abril-2011&Itemid=54&showall=1 .

of Costa Rican territory in the northern sector of Isla Portillos,[104] which Nicaragua has already attempted to unlawfully annex by military force.

C. The Emergency Decree and its Implementation

2.25 In response to Nicaragua's hostile conduct towards Costa Rica, explained in the preceding paragraphs, in December 2010 Costa Rica commenced infrastructure work to improve dirt paths between Delta Colorado and the town of Fatima and later on to Boca Sarapiquí, in order to render the road usable for vehicle access. Shortly thereafter, in accordance with the request made by Costa Rica's Minister of Public Security, it was decided that it was necessary to provide land access to other police posts at Los Chiles, Boca San Carlos, and Puerto Lindo. This entailed improvement works on tracks that connected those police posts to other Costa Rican communities, and in some cases constructing new sections of road. It was also decided that it was necessary to construct a road along the border to connect all the communities in these remote areas, to allow public authorities and the local population to mobilize if necessary, particularly in the event that an armed conflict instigated by Nicaragua were to break out, and to provide a means for the provision of other essential services to these areas. **Sketch Map 4** illustrates how the Border Road was conceived to provide efficient land access to all of Costa Rica's police posts along this part of its territory and to allow the mobilization of its citizens in case of need.

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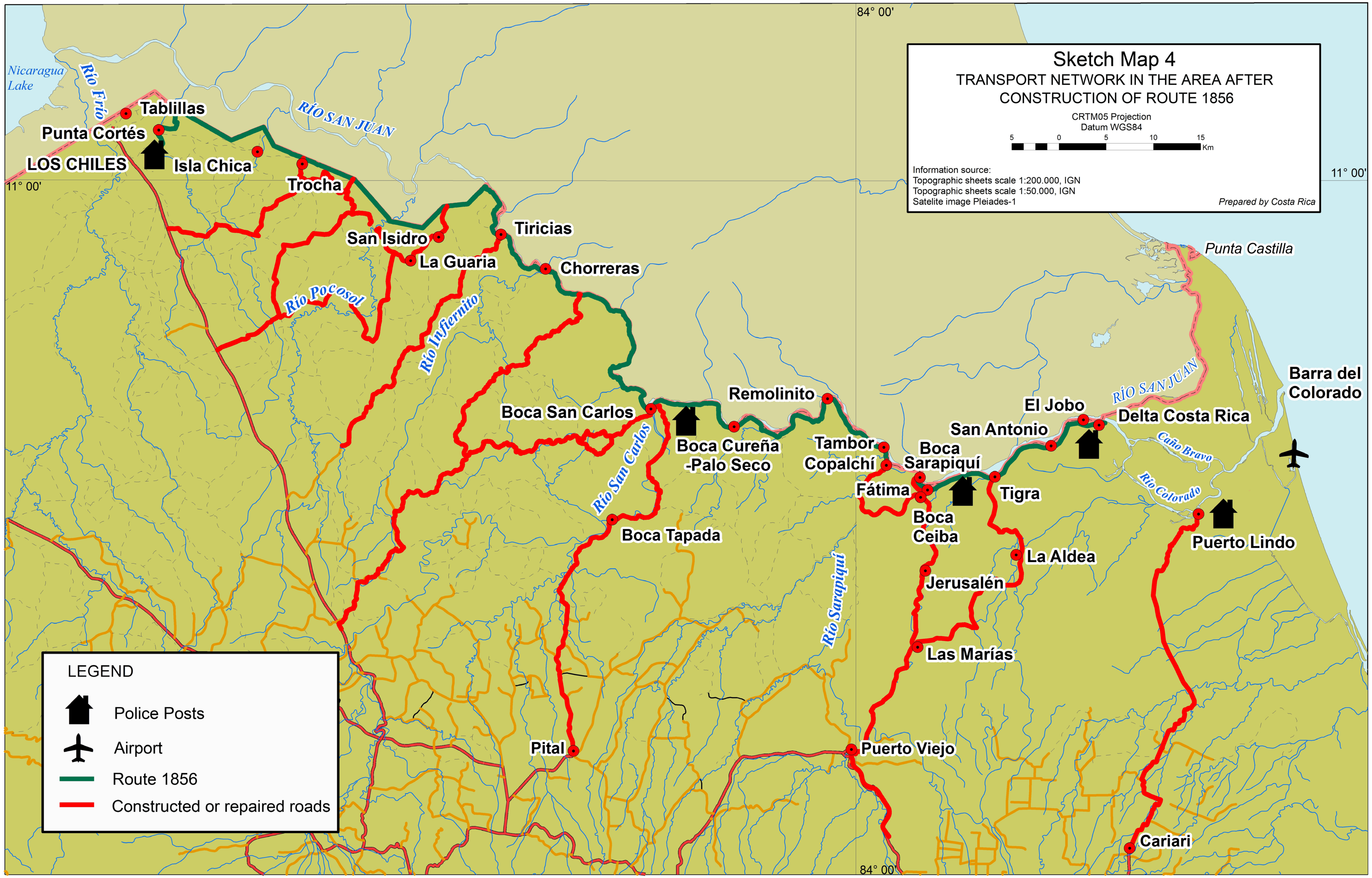
[104] **Vol 3, Annex No 80,** El 19 (Nicaragua), '33rd Anniversary of the Naval Force', 14 August 2013, available at http://www.el19digital.com/index.php/discurso/ver/12213/33-aniversario-de-la-fuerza-naval- .



Sketch Map 4
TRANSPORT NETWORK IN THE AREA AFTER CONSTRUCTION OF ROUTE 1856
CRTM05 Projection
Datum WGS84
5 0 5 10 15 Km
Information source:
Topographic sheets scale 1:200.000, IGN
Topographic sheets scale 1:50.000, IGN
Satelite image Pleiades-1
Prepared by Costa Rica
LEGEND
Police Posts
Airport
Route 1856
Constructed or repaired roads
84° 00'
11° 00'
Nicaragua Lake
Río Frío
RÍO SAN JUAN
Tablillas
Punta Cortés
LOS CHILES
Isla Chica
Trocha
San Isidro
La Guaria
Tiricias
Chorreras
Río Pocosol
Río Infiernito
Boca San Carlos
Río San Carlos
Boca Cureña -Palo Seco
Remolinito
Tambor
Copalchí
Boca Sarapiquí
Fátima
Boca Ceiba
Boca Tapada
Río Sarapiquí
Punta Castilla
El Jobo
San Antonio
Delta Costa Rica
Barra del Colorado
Caño Bravo
Río Colorado
Tigra
La Aldea
Jerusalén
Las Marías
Puerto Lindo
Pital
Puerto Viejo
Cariari

2.26 These initial road works, carried out in a situation of emergency, focused solely on building a very basic roadway. This explains why there was not a long and complex tendering process for designs, for example. It also explains the rudimentary condition which some sectors of the Road are in today, pending completion of the design and construction phase. The works undertaken were an urgent response to the emergency that had been declared.

2.27 The Border Road was initially envisaged to connect Delta Colorado with Los Chiles, though the possibility of extending it along the length of the border up to Bahía Salinas was not ruled out in light of President Ortega's references to Guanacaste. With the aforementioned needs in mind, and in order to provide the proper legal framework to carry out the necessary works, on 21 February 2011 the Costa Rican Government issued Executive Decree 36440-MP, entitled "To Declare that the Situation brought about by the Violation of Costa Rican Sovereignty by Nicaragua constitutes a State of Emergency", published in the Official Gazette number 46 of 7 March 2011 (the ***Emergency Decree***).[105]

2.28 A 'state of emergency' is defined under Costa Rican law as:

> "[A] [s]tatement made by the Executive Branch, by executive decree, based on a state of necessity and urgency, caused by circumstances of war, internal unrest and public calamity. This declaration allows for the management, by way of exception, of the actions and the allocation of resources necessary to address the emergency, in accordance with Article 180 of the Constitution".[106]

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105 NM, Annex 11.

106 **Vol 3, Annex No 23**, Costa Rica, National Law of Emergencies and Risk Prevention, Law No. 8488 of 11 January 2006, Article 4.

The declaration of a state of emergency triggers a number of public duties in the areas of health, security, the environment, public infrastructure, and the provision of other public services.

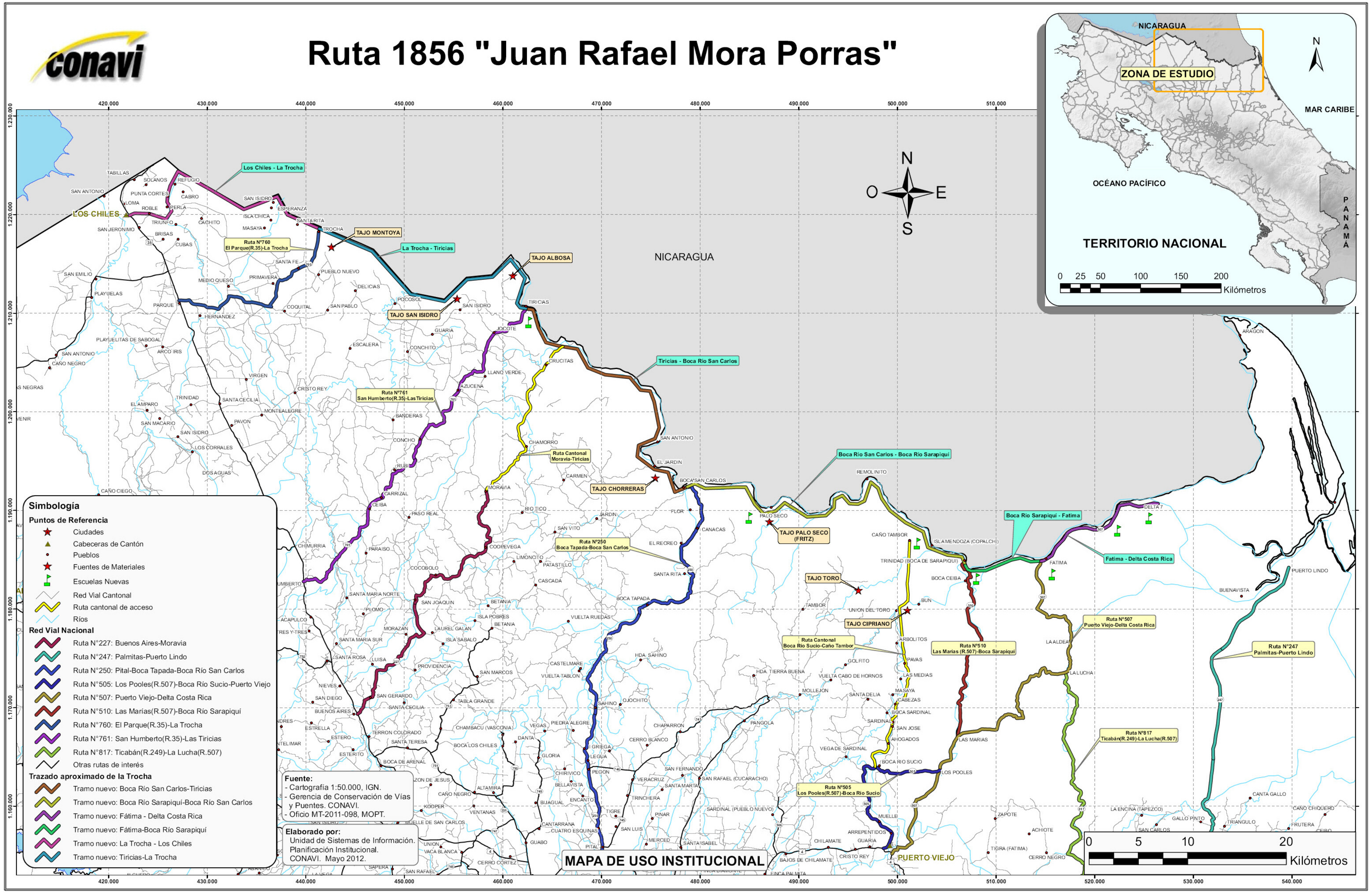
2.29 Article 1 of the Emergency Decree declared a state of emergency in the municipal jurisdictions along the entire length of the border between Costa Rica and Nicaragua: La Cruz, Upala, Los Chiles, Sarapiquí, San Carlos and Pococí.[107] Article 3 of the Decree sets out the purpose of the Decree and provides that:

> "The present declaration of a state of emergency encompasses all the actions and projects necessary for the protection of life, physical integrity [of persons], property and the environment, as well as those necessary for the maintenance, rehabilitation, reconstruction and restoration of infrastructure, housing, communications and disrupted production activities as well as all damaged public services within the zone covered under article 1) of this Decree…"[108]

2.30 Given the emergency situation in which the work was to be carried out, the Department known by the Spanish acronym "CONAVI" of Costa Rica's Ministry of Public Works and Transportation, acting pursuant to the Decree, engaged the services of several local contractors to carry out the necessary works on the Border Road. In order to advance the work in the pressing circumstances of the national emergency, the Border Road was divided into five sections. Each of these was assigned to a different contractor, with the intention that work could be carried out simultaneously in all of them. **Figure 2.2** is the official map prepared by CONAVI, showing both the road connecting Los Chiles to Delta Colorado as well as

[107] **Vol 3, Annex No 28**, Executive Decree 36440-MP, published in the Official Gazette number 46 of 7 March 2011, Article 1.

[108] *Ibid*, Article 3.



conavi
Ruta 1856 "Juan Rafael Mora Porras"
NICARAGUA
ZONA DE ESTUDIO
MAR CARIBE
OCÉANO PACÍFICO
TERRITORIO NACIONAL
0 25 50 100 150 200
Kilómetros
N
O
E
S
LOS CHILES
PUERTO VIEJO
Los Chiles - La Trocha
La Trocha - Tiricias
Tiricias - Boca Rio San Carlos
Boca Rio San Carlos - Boca Rio Sarapiqui
Boca Rio Sarapiqui - Fatima
Fatima - Delta Costa Rica
TAJO MONTOYA
TAJO ALBOSA
TAJO SAN ISIDRO
TAJO CHORRERAS
TAJO PALO SECO (FRITZ)
TAJO TORO
TAJO CIPRIANO
Ruta N°760 El Parque(R.35)-La Trocha
Ruta N°761 San Humberto(R.35)-Las Tiricias
Ruta Cantonal Moravia-Tiricias
Ruta N°250 Boca Tapada-Boca San Carlos
Ruta Cantonal Boca Rio Sucio-Caño Tambor
Ruta N°510 Las Marias (R.507)-Boca Sarapiqui
Ruta N°507 Puerto Viejo-Delta Costa Rica
Ruta N°247 Palmitas-Puerto Lindo
Ruta N°817 Ticabán(R.249)-La Lucha(R.507)
Ruta N°505 Los Pooles(R.507)-Boca Rio Sucio
Simbología
Puntos de Referencia
Ciudades
Cabeceras de Cantón
Pueblos
Fuentes de Materiales
Escuelas Nuevas
Red Vial Cantonal
Ruta cantonal de acceso
Ríos
Red Vial Nacional
Ruta N°227: Buenos Aires-Moravia
Ruta N°247: Palmitas-Puerto Lindo
Ruta N°250: Pital-Boca Tapada-Boca Rio San Carlos
Ruta N°505: Los Pooles(R.507)-Boca Rio Sucio-Puerto Viejo
Ruta N°507: Puerto Viejo-Delta Costa Rica
Ruta N°510: Las Marías(R.507)-Boca Río Sarapiquí
Ruta N°760: El Parque(R.35)-La Trocha
Ruta N°761: San Humberto(R.35)-Las Tiricias
Ruta N°817: Ticabán(R.249)-La Lucha(R.507)
Otras rutas de interés
Trazado aproximado de la Trocha
Tramo nuevo: Boca Rio San Carlos-Tiricias
Tramo nuevo: Boca Rio Sarapiquí-Boca Rio San Carlos
Tramo nuevo: Fátima - Delta Costa Rica
Tramo nuevo: Fátima-Boca Río Sarapiquí
Tramo nuevo: La Trocha - Los Chiles
Tramo nuevo: Tiricias-La Trocha
Fuente:
- Cartografía 1:50.000, IGN.
- Gerencia de Conservación de Vías y Puentes. CONAVI.
- Oficio MT-2011-098, MOPT.
Elaborado por:
Unidad de Sistemas de Información.
Planificación Institucional.
CONAVI. Mayo 2012.
MAPA DE USO INSTITUCIONAL
0 5 10 20
Kilómetros

access roads to the border. It shows the five different sections of the Border Road which were assigned to different contractors in different colours. The colour key to the map identifies the pre-existing dirt paths that were rehabilitated or improved, as well as those sections that are entirely new.

2.31 The contractors hired by CONAVI had to implement solutions of a temporary nature, such as installing small bridges and culverts using logs and metal containers. These temporary solutions were used to put in place basic infrastructure to provide provisional access to towns and locations along the border that had no other viable means of access. This was done in case such access became necessary in light of a national emergency, as well as to allow the mobilization of machinery and construction personnel from one location to another to advance the works on the Border Road. As explained above, these works were required in order to create new points of access to different parts of the border with Nicaragua, and to create a continuous thoroughfare along the entire length of the border from Los Chiles to Delta Costa Rica. The idea was to consolidate a basic gravel road, which the local Costa Rican media termed "*trocha*" ('track').

2.32 Initially, the work progressed in an efficient and expedited manner. However, funds were depleted by December 2011, and in early 2012 work progressed more slowly. Before the project could be finalized, on May 2012 the Government of Costa Rica exposed and denounced apparent acts of corruption, involving government officials from CONAVI in charge of the construction and supervision of the Border Road and some private contractors. This prompted immediate action on the part of the Costa Rican administrative and judicial authorities, and a large-scale investigation was launched. As a consequence, the road works were suspended.

2.33 The Emergency Decree has been the subject of three separate cases before Costa Rica's Constitutional Court.[109] In every one of these cases, the Constitutional Court has upheld the Decree as being in accordance with Costa Rica's Constitution.[110] The road works are thus in full compliance with Costa Rican law. Due to the national emergency precipitated by Nicaragua's actions, and consistent with the previous jurisprudence of the Costa Rican Constitutional Court,[111] Costa Rica was not under any domestic legal obligation to conduct environmental studies or present detailed designs of the Border Road. Nicaragua's assertions to the contrary have no basis.[112]

2.34 Under Costa Rican law, the requirement to carry out an environmental impact assessment before commencing work on a project is displaced in circumstances where there is an emergency. Costa Rica's Constitutional Court has recognised that the urgency brought about by a state of emergency means that the requirement to carry out an EIA is excluded. It stated:

> "It is therefore not contrary to the Law of the Constitution that the concerned public institutions are exempted at the proper moment from the steps and procedures of the ordinary functioning of the Administration, which in this case refer to the exemption of environmental regulations, as are, for example, the completion of the environmental impact assessment or technical reporting by competent

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109 Separate cases challenging the constitutionality of the decree were filed by three individuals.

110 See **Vol 3, Annex No 31**, Costa Rica, Constitutional Court Judgment No 2012-3266, of 7 March 2012; **Vol 3, Annex No 30**, Costa Rica, Constitutional Court Judgment No 2012-8420, of 22 June 2012; and **Vol 3, Annex No 32**, Costa Rica, Constitutional Court Judgment No 2013-008257, of 21 June 2013.

111 See **Vol 3, Annex No 21**, Costa Rica, Constitutional Court Judgment No 06322-2003 of 3 July 2003; and **Vol 3, Annex No 24**, Costa Rica, Constitutional Court Judgment No 006336-2006 of 10 May 2006.

112 NM, para. 2.20.

> institutions due to the state of need and emergency, which made it impossible to wait for the conclusions of these reports."[113]

2.35 Instead, in such circumstances, under Costa Rican administrative regulations, an activity carried out without an EIA, may be later assessed by undertaking a study similar to an EIA; this study is designated an "Environmental Diagnostic".[114] This type of study has two main objectives: first, to identify any negative impacts and risks of the activity on the environment; and second, to recommend environmental control measures necessary to prevent or to mitigate those negative impacts and risks. In relation to the 1856 Road, the Costa Rican Government commissioned an Environmental Diagnostic, which was carried out by a team of experts from the Tropical Science Center, a well-respected Costa Rican organization established in 1962. The Center has extensive experience in scientific environmental research in areas subject to tropical conditions, including environmental impact assessments. The Environmental Diagnostic covers the entire 108 km of the Road in the vicinity of the San Juan River, from Boundary Marker 2 to Delta Colorado. It considers the existing physical environment where the Road is constructed, including the climate, hydrology, terrestrial and aquatic flora and fauna, and ecology. It incorporates recommendations for the work to complete the Road, taking account of any potential risk of environmental impact. The Environmental Diagnostic fully complies with the guidelines established by Costa Rican administrative regulations for a project of this type. Costa Rica has carried

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113 **Vol 3, Annex No 24**, Costa Rica Constitutional Court Judgment N° 006336-2006 of 10 May 2006.

114 **Vol 3, Annex No 27**, Costa Rica, Ministerial Resolution 02752 of 2009, Technical Guide for an Environmental Diagnostic – EDA, 2 November 2009.

out the Environmental Impact Diagnostic for the Road and it is **Annex 10** to this Counter-Memorial.

2.36 Under Nicaraguan domestic law, the normal requirement to undertake an EIA may similarly be displaced to permit projects intended to mitigate disasters or undertaken in the national interest or for national security reasons in response to situations of national emergency.[115] The domestic law of other countries also has similar exemptions.[116]

2.37 Contrary to Nicaragua's assertion,[117] the construction of the Road is not a form of unlawful self-help. It was embarked upon in the emergency circumstances created by Nicaragua, in order to provide essential services to the population and to enable Costa Rican police to mobilize in the event of a further armed incursion by Nicaragua, which in the context of Nicaragua's repeated provocations appeared to be a very real risk. It was not taken to aggravate tensions between the two States, nor to undermine respect for the judicial process. Rather, Costa Rica's decision to construct a Road entirely on its own territory was a reasonable and proportionate response to the risk it perceived at that time.

2.38 Since April 2012, in order to protect the work that has been carried out so far and to mitigate the effects of the road (primarily in respect of Costa Rican territory), Costa Rica has been carrying out additional maintenance and remedial works on the Border Road. The maintenance and

115 **Vol 3, Annex No 25**, Nicaragua, Decree No. 76-2006, approved on 19 December 2006, published in La Gaceta No. 248 of 22 December 2006, Article 12, available at http:// www.ine.gob.ni/DCA/leyes/decreto/Decreto_76-2006_SistemaEvaluacionAmbiental.pdf .

116 See, for example, Australia, Environment Protection and Biodiversity Conservation Act 1999 (Cth), in force from16 July 2000, s. 158(5).

117 Cf. NM, para. 5.15.

remedial works that were completed between February and April of this year are detailed in a series of reports annexed to this Counter-Memorial.[118] These works include:

(a) placement of sediment control barriers, including silt fences, to intercept eroded sediment;

(b) placement of geoblankets made out of coconut fibre on slopes and other disturbed areas to prevent sheet and rill erosion;

(c) excavation of slopes on embankments to remove loose fills, and the filling of these slopes with compacted soil to ensure stability;

(d) placement of culverts and corresponding headwalls to control the run-off at small stream crossings;

(e) lining of drainage channels to improve run-off management;

(f) construction of sediment traps to intercept eroded sediment;

(g) construction of concrete energy dissipaters to reduce sediment transport;

(h) stabilisation of slopes to reduce the probability of mass failures;

(i) building of top ditches to reduce positive pore water pressures in the soil;

(j) hydro-seeding of slopes to control surface run-off and reduce sheet and rill erosion;

(k) placement of ballast to eliminate erosion of the road bed;

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118 **Vol 2, Annex No 8**, Consejo Nacional de Vialidad (CONAVI), *Program for the Consolidation and Continued Improvement of Route No 1856*, Reference DIE-02-13-3107, 2 October 2013; **Vol 2, Annex No 7**, Report from Ana Lorena Guevara Fernández, Vice-Minister of the Environment, Costa Rica, to Enrique Castillo Barrantes, Minister of Foreign Affairs, Costa Rica, Reference DVM-293-2013, 8 October 2013; and **Vol 2, Annex No 2,** Comisión de Desarrollo Forestal de San Carlos (CODEFORSA), Consulting Services for the Development and Implementation of an Environmental Plan for the Juan Rafael Mora Porras Border Road, *Report of Activities to the Ministry of Foreign Affairs of the Republic of Costa Rica*, January 2013.

(l) construction of step drains to reduce energy in a concentrated run-off to prevent gullying;

(m) lining of exit channels to reduce erodibility of channel surfaces;

(n) benching to create stable slopes to prevent landslides;

(o) removal of landslides caused by inadequate slope structure to reduce erosion of failed materials;

(p) improvement of water passages by putting in place the necessary infrastructure such as buttress in order to reduce sediment transport by improved run-off management;

(q) cleaning of drain structures and lined ditches to maintain hydraulic function;

(r) repairing of bridges to prevent erosion at stream crossings;

(s) removal of debris from channels to maintain hydraulic capacity; and

(t) manual planting of 27,000 trees of native species.

2.39 The photographs below are illustrative of some of the remedial works that have already been carried out:

Figure 2.3 The Road near Marker II (a) prior to mitigation work on 15 February 2013 and (b) on 7 May 2013 with mitigation measures in place.[119]

Figure 2.4 Road at East 502480, North 321561, close to the Río Infiernito (a) on 15 February 2013, and (b) the same stretch of road on 7 May 2013.[120]

2.40 Further works are currently being undertaken, and detailed plans are in place for future remediation works. In addition to the 27,000 trees of native species already planted in different sites along the Road, which currently range in height between one and three metres; the planting of a

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119 **Appendix A**, Professor Colin Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, p. 110, Figure 39 (photographs taken by Professor Thorne).

120 *Ibid*, p. 113, Figure 43 (photographs taken by Professor Thorne).

further 25,000 trees commenced in September 2013.[121] Costa Rica will also undertake works at seven targeted locations between Marker II and Delta Costa Rica. Work at three of these locations, between the town of Tiricias and east of the Infiernito River, and the location of Cureña River, east of Boca San Carlos, will be carried out directly by Costa Rica's Ministry of Public Works, with its own machinery and personnel. Manual labour will be used at the other locations in order to avoid using heavy machinery that might create additional disturbances. The Ministry of the Environment is in the process of contracting an NGO specializing in this kind of work. These works will include the stabilization of slopes, building ditches, culverts and sediment traps, as well as planting of vegetation. Thus Costa Rica's remediation work on the Road is continuing.

2.41 Costa Rica will bring the road works to completion for the benefit of its inhabitants and for the protection of its territory and sovereign rights. In doing so, it will adhere to high environmental and engineering standards. To that end, it has commenced a public tendering process for the complete designs of the Road.[122] Costa Rica will also continue to carry out maintenance and remediation works on the Road, to address any risk of significant impact.

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121 **Annex 2, Vol 7**, Report from Ana Lorena Guevara Fernández, Vice-Minister of the Environment, Costa Rica, to Enrique Castillo Barrantes, Minister of Foreign Affairs, Costa Rica, Reference DVM-293-2013, 8 October 2013, p. 2.

122 CR 2013/29, pp. 17-18, para. 17 (Brenes).

Chapter 3

The Absence of Adverse Impact on the San Juan River

A. Nicaragua's Case in Brief

3.1 Nicaragua claims that the construction of the road "is causing Nicaragua significant transboundary harm".[123] It argues that the Road has caused, and will continue to cause, harm "in the form of massive sedimentation and other pollution of the River, with attendant adverse impacts on water quality, aquatic life, navigation, and other general uses and enjoyments of the River by local residents and businesses."[124] It requests the Court to declare that Costa Rica has breached its "obligation not to damage Nicaraguan territory" and its "obligations under general international law and the relevant environmental conventions".[125]

3.2 Nicaragua's claims are based on the allegation that the construction of the Road has caused high volumes of sediment to be delivered to the San Juan.[126] It claims that these high volumes of sediment have had a negative impact upon:

(a) water quality;

(b) morphology of the River;

(c) navigation; and

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123 NM, para. 5.58. See also paras. 3.3 and 3.60.

124 NM, para. 3.60.

125 NM, Submissions, paras. 1(ii) and (iii).

126 NM, para. 3.60.

(d) the ecosystem (including aquatic life and fishing), tourism and health.[127]

3.3 Nicaragua's case rests entirely on the hypothesis that the Road is contributing massive and harmful quantities of additional sediment to the River. The true picture as to sedimentation is set out in **Section B** below. Each of the specific allegations as to adverse impact is addressed in **Section C** below. Finally, Nicaragua's misplaced reliance on the "Judgment" of the Central American Court of Justice is discussed in **Section D** below. Conclusions are listed in **Section E**.

B. Sedimentation: the True Picture

3.4 At the outset, it must be kept in mind that sediment is not a pollutant. Rather, the contribution of sediment to a river such as the San Juan is a natural process, and one which is essential to the life of the River. This process is commonly regarded as beneficial.[128]

3.5 Nicaragua's allegations of adverse impact are based on the contribution of sediment from the Road to the River.[129] To assess these allegations it is necessary first to consider the existing sediment load of the River, in order to establish the baseline from which any impact of additional sediment may be measured.

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127 NM, para. 3.81.

128 See, eg, **Vol 3, Annex No 81,** GM Kondolf, "Hungry water: Effects of dams and gravel mining on river channels" 21(4) (1997) *Environmental Management* 533.

129 See, eg, NM, paras. 1.9, 1.11, 1.12, 1.13, 2.45, 3.2, 3.3, 3.8, 3.14, 3.20, 3.22, 3.24, 3.26, 3.38, 3.41, 3.43, 3.48, 3.49, 3.57, 3.58, 3.59, 3.60, 3.63, 3.67, 3.74, 3.76, 3.78, 3.79, 3.80, 3.81, 3.88, 3.90, 3.92, 3.96, 4.1, 4.13, 4.15, 4.19, 4.32, 4.41 and 6.14.

3.6 Nicaragua has not produced any evidence as to the existing sediment load of the San Juan River. It merely asserts that the contribution of additional sediment – which it estimates on the basis of the opinion expressed by Dr Kondolf – has had an adverse impact on the River.[130] But the impact of this estimated additional sediment can only be assessed in the context of the quantity and variability of the baseline sediment load – i.e., the sediment load of the River as it was before the Road was constructed and as it is now, but excluding any addition of sediment due to construction of the Road.

3.7 In contrast to Nicaragua's approach, Costa Rica has produced comprehensive scientific and technical evidence relating to the impact of the Road on the San Juan River. These reports squarely address the question whether the Road is contributing sediment to the River, and if so, how much sediment, and they also consider the relative impact of this sediment in the context of the existing sediment load of the River. These reports are the following:

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130 The following documents submitted by Nicaragua are relevant: **NM, Annex 1**, G. Mathias Kondolf, *Environmental Impacts of Juan Rafael Mora Porras Route 1856, Costa Rica, on the Río San Juan, Nicaragua*, December 2012 (the ***2012 Kondolf Report***); G. Mathias Kondolf, *Confirmation of Urgent Measures to Mitigate Erosion & Sediment Delivery from Rte 1856, Costa Rica, into the Río San Juan, Nicaragua*, 12 October 2013 (the ***Second Kondolf Report***), submitted by Nicaragua in support of its application for provisional measures in this case; G. Mathias Kondolf, *Continued Impacts of Erosion from Rte 1856, Costa Rica to the Río San Juan, Nicaragua*, 30 October 2013 (the ***Third Kondolf Report***), also submitted by Nicaragua in support of its application for provisional measures in this case; G. Mathias Kondolf, *Selected Photographs of Depositional Features along the Río San Juan de Nicaragua caused by Costa Rican Route 1856 Construction, Poor Design and Lack of Maintenance. Photos taken May 20-22, 2013* (***Appendix A to the Third Kondolf Report***), which accompanies the Third Kondolf Report; and G. Mathias Kondolf, *Comments on Costa Rican Submissions of November 2013*, 6 November 2013 (the ***Fourth Kondolf Report***), submitted as Tab 21 of Nicaragua's Judges' Folders, 7 November 2013. In addition, in response to a request from Costa Rica, Nicaragua provided further information relating to the location of 54 "sediment delivery points" which were noted in the 2012 Kondolf Report.

(a) Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River,* August 2013 (the ***ICE Report***) (**Annex 4**; also submitted as Attachment CR-1 on Nicaragua's Request for Provisional Measures);[131]

(b) University of Costa Rica Centre for Research in Sustainable Development, Department of Civil Engineering, *Report on Systematic Field monitoring of Erosion and Sediment Yield along Route 1856*, September 2013 (the ***UCR Report***) (**Annex 1**; also submitted as Attachment CR-2 on Nicaragua's Request for Provisional Measures); and

(c) Allan Astorga G. and Andreas Mende, *Route 1856: analysis of the change in land use based on satellite images before and after the construction of the border road*, August 2013 (the ***Land Use Change Report***) (**Annex 3**; also submitted as Attachment CR-4 on Nicaragua's Request for Provisional Measures);

(d) Andreas Mende and Allan Astorga G., *Inventory of Slopes and Water Courses related to the Border Road No 1856 between Mojón II and Delta Costa Rica*, October 2013 (the ***Inventory of Slopes and Water Courses***) (**Annex 6**); and

131 The Department of Hydrology of the Costa Rican Institute of Electricity has responsibility for monitoring of sediment in Costa Rica's basins and micro basins: see **Vol 2, Annex 4**, Costa Rican Institute of Electricity (ICE), SBU Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River,* August 2013 (the ***ICE Report***), p. 2.

(e) Andreas Mende, with Allan Astorga G. and Olivier Chassot, *Border Road No 1856 – Evaluation of the 54 Sites of Purported Direct Sediment Delivery mentioned by Ph.D. Mathias Kondolf*, September 2013 (the ***54 Sites Report***) (**Annex 5**).

3.8 In addition, a team of experts from the Tropical Science Centre (CCT, in its Spanish acronym) have carried out an Environmental Diagnostic Assessment, pursuant to Costa Rican administrative regulations. This Environmental Diagnostic Assessment (the ***CCT Report***) is submitted as **Annex 10** to this Counter-Memorial.

3.9 Costa Rica's experts have engaged in a detailed study of past and current sediment loads, and have estimated the contribution of sediment from the Road to the River through scientific field monitoring and computer modelling exercises. Their methodology and the results of their research have been assessed by Professor Colin Thorne, an independent expert with over 35 years of experience in sedimentation and river morphology.[132] Costa Rica submits with its Counter-Memorial the independent expert report of Professor Thorne concerning the impact of the Road on the San Juan River, together with the technical reports listed above (see Professor Thorne, *Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River*, November 2013, **Appendix A** to this Counter-Memorial (the ***Thorne Report***). Professor Thorne explains his methodology in his Report, including his participation in site visits to the Road, during

[132] See Fourth Kondolf Report, pp. 8-9, acknowledging Professor Thorne's qualifications.

which he drove along and/or viewed from air the entire length of the Road.[133]

(1) Impact of the Road on the suspended sediment load of the San Juan River: before and after

3.10 In order to assess the impact, if any, of the Road, Costa Rica's experts first considered the suspended sediment load of the River before and after construction of the Road. This was done to assess whether, as Nicaragua asserts, "the increased sediment load resulting from the Road and its construction" has and will cause significant harm to Nicaragua[134] and whether, as Dr Kondolf asserts, the Road has "increased sediment delivery to the Río San Juan".[135] As Professor Thorne explains, Costa Rica's technical experts:

> "… examine[d] measured suspended sediment concentration in the Río San Juan in order to ascertain whether erosion and sediment delivery from the Road has significantly increased the sediment load of the Río San Juan."[136]

3.11 To undertake this comparison, it was necessary first to assess the baseline of the suspended sediment load of the San Juan River prior to the construction of Route 1856. For this purpose, recourse was had to available records in the pre-construction period, which date from 1974-1976. The measurements of Suspended Sediment Concentration in the San Juan made during this period were recorded jointly by the two parties, and were relied

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133 **Appendix A**, Thorne Report, para. 3.3. See also Chapter 5 of **Appendix A**, setting out Professor Thorne's field observations.

134 NM, para. 1.12.

135 **NM, Annex 1**, 2012 Kondolf Report, para. 4.11.

136 **Appendix A**, Thorne Report, para. 8.2.

upon by Nicaragua in the *Navigational Rights* case.[137] They were recorded at La Trinidad on the San Juan River, close to the mouth of the Sarapiquí. On the basis of their provenance and that they were recorded over a period of two years, Professor Thorne concludes that these measurements "provide a reasonable indication of [Suspended Sediment Concentrations] in the Río San Juan prior to construction of the Road."[138] From these measurements, the annual suspended sediment load in the San Juan was calculated by combining the measurements of Suspended Sediment Concentration with the average volume of water flowing through the River annually during the relevant period (referred to as the average annual hydrograph).[139] The average annual suspended sediment load for 1974-1976 was about 7,995,000 t y^{-1}.[140]

3.12 The total sediment load of a river is calculated taking account of the suspended sediment load (i.e. the sediment carried along in the water column) and the bed load (i.e. the material carried by being bounced or rolled along its bed). However, Nicaragua and Costa Rica did not measure the bed load of the River in 1974-1976.[141] For this reason, the comparison reported here was made only between the pre- and post-Road suspended sediment loads.

3.13 The average annual suspended sediment load in the San Juan in 1974-1976, i.e. before construction of the Road, was compared with the

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137 *Navigational Rights*, NCM, para 1.1.8.

138 **Appendix A**, Thorne Report, para. 6.29.

139 *Ibid*, para. 6.27.

140 *Ibid*, para. 8.8 and Table 10.

141 *Ibid*, para. 8.2.

average annual suspended sediment load in the San Juan after construction of Route 1856. The suspended sediment load for the period after construction of the Road was calculated using Suspended Sediment Concentration measurements from the period December 2010 to June 2013. These measurements were taken from a sediment monitoring station on the Río Colorado at Delta Colorado, i.e. on Costa Rican territory, and were recorded by the hydrology department of the Costa Rican Institute of Electricity, which has responsibility for monitoring of sediment in Costa Rica's basins and micro basins.[142] The measurements taken at Delta Colorado are comparable to those taken on the San Juan River at La Trinidad (in 1974-1976), because about 90% of the flow and sediment that passes through La Trinidad also passes through Delta Colorado.[143] The measurements taken at Delta Colorado over the two and a half-year period from December 2010 to June 2013 indicate that the average annual suspended sediment load in the Río Colorado was 5,981,000 t y^{-1}.[144] The suspended sediment load measured in the Río Colorado at the Delta Colorado station may be adjusted to represent that in the Río San Juan upstream of the Delta by multiplying it by the reciprocal of 0.91. Applying this adjustment, the average annual suspended sediment load in the Río San Juan between December 2010 and June 2013 was approximately 6 573 000 t y^{-1}.[145]

3.14 The two measurements of the average suspended sediment load (before and after construction of the Road) were then compared. In the

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142 See **Vol 2, Annex 4**, ICE Report, p. 2.

143 **Appendix A**, Thorne Report, para. 8.3.

144 *Ibid*, para. 8.8 and Table 10.

145 *Ibid*, para. 8.10 and Table 10.

graphic below, the “before” measurements are reflected in the blue column; the “after” measurements are indicated in red. As can be seen, the sediment load carried by the San Juan in the period since construction of the Road is actually *lower* than it was before the Road was constructed. On the basis of these data, Professor Thorne concluded that “This result demonstrates that construction of the Road has not led to a significant increase in the [Suspended Sediment Load] carried by the Río San Juan.”[146]

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[146] **Appendix A**, Thorne Report, para. 8.13.

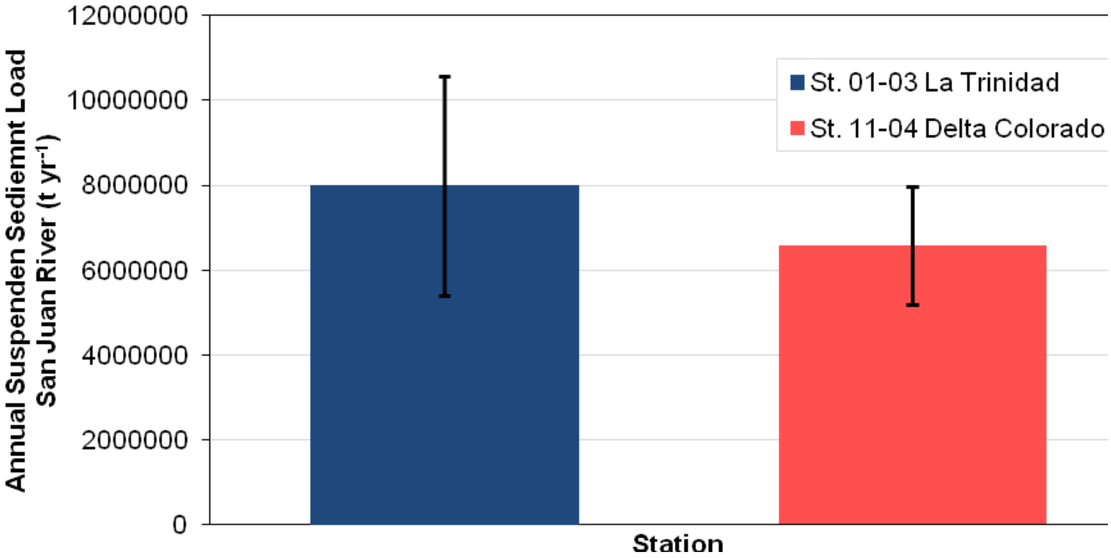

Figure 27. Mean annual suspended sediment loads in the Río San Juan based on measurements at La Trinidad (1974-1976) and Delta Colorado (2010-2013). Vertical bars indicate 95% confidence intervals. Note that the loads based on measurements at Delta Colorado station have been adjusted to represent the Río San Juan on the basis that at the Delta suspended load is divided in the same proportion as discharge (from the ICE Report).[147]

(2) Estimates of sediment eroded from the Road to the River

3.15 In order to confirm whether the Road has had or is having any adverse impact on the San Juan River, Costa Rica's experts then considered the extent to which the Road is contributing sediment to the River. Based on his visual observations of the Road from the River and from the air, Dr Kondolf estimates that cut and fill slopes along the Road are eroding – i.e. the land surface is lowering – at an average rate of 1m per year.[148] He estimates that erosion at this rate is occurring on 40% to 50% of the slopes

[147] Caption taken from Figure 27 to **Appendix A**, Thorne Report; the same figure is produced as Figure 5 to **Vol 2, Annex 4**, ICE Report.

[148] **NM, Annex 1**, 2012 Kondolf Report, p. 46; see also Third Kondolf Report, p. 2.

along the Road. Dr Kondolf estimates that 40% of the sediment eroded from the Road is delivered to the River.[149] Taking into account these three sets of estimates, Dr Kondolf concludes that between 87,000 and 109,000 m^3y^{-1} of sediment is contributed from the Road to the River each year.[150]

3.16 Dr Kondolf's estimates were given in volumes (i.e. cubic metres). In order to compare them to the estimates made by Costa Rica's experts, Dr Kondolf's estimates were converted to masses (i.e. tonnes). For that purpose, it was assumed that a cubic metre of sediment has a mass of approximately 1.67 tonnes. As Professor Thorne explains, this is typical for closely-packed, quartz sand grains. It is high for soil, which has a higher porosity. As a result, assuming a mass of 1.67 tonnes is conservative.[151] When the volumes mentioned above are converted into masses, Dr Kondolf's estimate is between 145,290 and 182,030 t y^{-1}.

3.17 As Costa Rica noted during the oral hearings on Nicaragua's Request for Provisional Measures, of the entire 160 km of the Road, only 108 km runs along the San Juan River.[152] Of that 108 km, Dr Kondolf complains only about the first 41.6 km, from Marker II to the Río San Carlos.[153] As Professor Thorne explains, the terrain downstream of Boca

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149 **NM, Annex 1**, 2012 Kondolf Report, p. 46.

150 *Ibid*; see also Third Kondolf Report, p. 2.

151 **Appendix A**, Thorne Report, para. 8.55.

152 See **Vol 2, Annex No 3**, Allan Astorga G. and Andreas Mende, *Route 1856: Analysis of the Change in Land use Based on Satellite Images Before and After the Construction of the Border Road*, August 2013, p. 4; cf. Fourth Kondolf Report, p. 3, third paragraph (referring to 106 km); and CR 2013/31, p. 11, para. 15 (Parlett).

153 In his 2012 Report, Dr Kondolf said that this was because it has the steepest topography, and because of time constraints: **NM, Annex 1**, 2012 Kondolf Report, p. 9, third paragraph. The same approach was taken by Dr Kondolf in his three additional reports submitted a year later: the Second, Third and Fourth Kondolf Reports do not include any criticism of the remaining length Road beyond Boca San Carlos.

San Carlos is much flatter, and the Road follows a pre-existing road for a far greater proportion of its length, passing through areas that have long been inhabited and developed for pasture, crops, forestry and other uses.[154]

3.18 In his 2012 Report, Dr Kondolf states that he "documented direct delivery of sediment from road erosion to the river at 54 sites along the road."[155] Dr Kondolf did not provide any indication of the location of these points, nor did he provide geographic coordinates. In response to a request by Costa Rica for further information, Nicaragua provided to Costa Rica a document which listed the geographic coordinates of these 54 sites. Costa Rica was able to use these coordinates to verify the locations of these sites, and to assess whether they were in fact sites of sediment delivery from the Road to the River.[156] Of the 54 sites, seven were found to be in Nicaraguan territory on the left bank of the San Juan.[157] Of the remaining 47, ten were downstream of Boca San Carlos. These were all examined and analysed by Costa Rica's experts. Nine of the ten sites were between Boca San Carlos and Boca Sarapiquí. Of the nine points, seven were "of trivial significance or unrelated to the road".[158] The remaining two points refer to the confluence of the Rio Cureña and a nearby fill slope: as Professor Thorne notes, these points are downstream of where the Río San Carlos enters the Río San Juan, contributing in excess of 4.5 million t y^{-1}. In that context, any

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154 **Appendix A**, Thorne Report, para. 5.7.

155 **NM, Annex 1**, 2012 Kondolf Report, p. 45.

156 **Vol 2, Annex No 5,** Andreas Mende, with Allan Astorga G. and Olivier Chassot, *Border Road No 1856 – Evaluation of the 54 Sites of Purported Direct Sediment Delivery mentioned by Ph.D. Mathias Kondolf*, September 2013 (***54 Sites Report***).

157 **Appendix A**, Thorne Report, para. 5.12; **Vol 2, Annex No 5,** 54 Sites Report, p. 1.

158 **Appendix A**, Thorne Report, para. 5.14.

contribution of sediment from these two points is insignificant.[159] The final point identified was downstream of Boca Sarapiquí, at the mouth of the Caño Negro. When this site was examined, as Professor Thorne notes, there was "no evidence of even trivial delivery of sediment to the River."[160] Furthermore, at this point the San Juan carries nearly 9 million tonnes of sediment annually, so if there is sediment entering the River at this point, "it does so in quantities that are small in absolute terms and negligible in relative terms."[161]

3.19 On the basis of the field work undertaken by Costa Rica's experts, and on the basis of his own field observations, Professor Thorne concludes that "with respect to the actual and potential delivery of road-derived sediment to the Río San Juan [in the stretch from Boca San Carlos to Delta Costa Rica], there is nothing *to* say."[162] For this reason, the analysis which follows focuses on the first 41.6 km of the Road, from Marker II to Boca San Carlos.

3.20 Returning to Dr Kondolf's estimates of sediment delivered annually to the San Juan from the first 41.6 km of Road (145,290 to 182,030 t y^{-1}), to assess whether these estimates are reasonable, the Department of Civil Engineering at the University of Costa Rica monitored erosion from nine of the most active sites for sheet erosion; "rill" or "micro-channel" erosion;

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159 **Appendix A**, Thorne Report, para. 5.14.

160 *Ibid*, para 5.15.

161 *Ibid*,

162 *Ibid*, para. 5.16 (original emphasis).

landslides; and gullying.[163] Their study focussed on the area between Marker II and Río Infiernito, which is one of the sections of the Road which has the most landslides and gullies, and their results are therefore representative of the erosion which is likely to occur in the 41.6 km stretch of the Road from Marker II to Boca San Carlos.[164]

3.21 Based on the field monitoring done by UCR, the land surface lowering rates were estimated to be as follows:

(a) For sheet erosion of the road bed and slopes, the land lowering rate varied between 0.061 m y^{-1} and 0.095 m y^{-1}.[165] The range in the rates is attributable to the variation between the dry and wet seasons. Professor Thorne concludes that it is reasonable to assume that the average annual rate of lowering of the land surface due to sheet erosion along the entire length of the Road is 0.095 m y^{-1}. This estimate is conservative, for two reasons. First, it reflects the top end of the range which was derived from monitoring on the parts of the Road which are the most susceptible to erosion. Secondly, if used as the base value from which to estimate sheet erosion along the entire length of the Road, which is the approach which Costa Rica's experts have taken, the resulting estimate of sediment delivery from the Road to the River is further conservative.[166]

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163 **Vol 2, Annex No 1,** University of Costa Rica Centre for Research in Sustainable Development, Department of Civil Engineering, *Report on Systematic Field monitoring of Erosion and Sediment Yield along Route 1856*, September 2013 (the ***UCR Report***); **Appendix A**, Thorne Report, para. 8.21.

164 **Appendix A**, Thorne Report, para. 8.23; cf. Fourth Kondolf Report, pp. 3 and 9.

165 **Appendix A**, Thorne Report, para. 8.25.

166 *Ibid*.

(b) In respect of landslides on cut slopes, the land lowering varied between 0.11 to 0.38 m, over a period of two years. Landslides were observed to occupy 10 to 13% of the cut slopes. Therefore the average rate of lowering of the land surface per annum was between 0.06 m y^{-1} and 0.19 m y^{-1}.[167]

(c) In respect of gullies on cut slopes, the field monitoring indicated that the average lowering of the land surface was 0.005 m y^{-1}.[168]

(d) In respect of gullies on fill slopes, the field monitoring indicated that the average rate of land surface lowering was between 0.12 m y^{-1} and 0.20 m y^{-1}.[169]

(e) In respect of rill erosion on cut slopes, the field monitoring indicated that the average rate of land surface lowering was approximately 0.06 m y^{-1}.[170] This rate can also be applied to fill slopes; and doing so is conservative, because rill erosion of fill slopes appeared similar to that of cut slopes and the applied rate is based on the dimensions of the largest rill measured on the most severely rilled cut slope.[171]

3.22 Professor Thorne considered the methodology and results of the field monitoring conducted by the University of Costa Rica, and concluded that

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167 **Appendix A**, Thorne Report, para. 8.26. As Professor Thorne explains, landslides are a form of "mass wasting". All mass wasting is driven by gravity. Landslides are the largest in scale of the mass wasting processes. Since UCR treated all mass wasting as being by landslides, the erosion estimates derived therefrom is conservative: see **Appendix A**, Thorne Report paras. 8.40-41.

168 **Appendix A**, Thorne Report, para. 8.27.

169 *Ibid,* para. 8.30.

170 *Ibid,* para. 8.28.

171 *Ibid,* para. 8.29.

the results of the field monitoring indicate that Dr Kondolf's estimate of land surface lowering of 1 m per year is probably too high by a factor of five for the stretch of Road between Marker II and Río Infiernito. With respect to the entire 108 km of the Road, it is probably too high by a factor of ten.[172]

3.23 The field monitoring by UCR, as reviewed and analysed by Professor Thorne, also indicated that Dr Kondolf's estimate that this level of erosion is occurring on 40% to 50% of the relevant area of the Road was a "significant over-estimate."[173] Professor Thorne concludes:

> "In my experience, including my inspections of the Road in February and May 2012, of land surface lowering due to landslides and gullies averaging 1 m y^{-1} is too high and it is unlikely to be accurate, especially if applied to the entire length of the Road along the River. Also, the assumption that landslides and gullies cover 40 to 50% of slopes and other disturbed areas overstates the extent of these features. Conversely, the monitored rates and areas affected as summarised in [the UCR Report and Table 12 of the Thorne Report] are consistent with my own observations and, in my opinion, are likely to be more representative of conditions encountered in general along the Road."[174]

3.24 In order to assess whether sediment eroded from the Road is having any impact on the San Juan, ICE analysed the results of the field monitoring undertaken by UCR. Taking account of the length and steepness of the road bed, and the areas of cut slopes, fill slopes and other disturbed areas along the full length of the Road (which were examined and assessed in the

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172 **Appendix A**, Thorne Report, para. 8.34.

173 *Ibid*, para. 8.35.

174 *Ibid*, para. 8.36.

Inventory of Slopes and Water Courses Report[175] and the *Land Use Change Report*[176]), ICE calculated the estimated average annual erosion rate by volume to be 60,780 m^3 yr^{-1}, which converts to 101,550 t y^{-1}.[177]

3.25 As noted in paragraph 3.15 above, Dr Kondolf estimated that 40% of the sediment eroded from the Road reaches the San Juan.[178] However, ICE took a more conservative approach, estimating that 60% of sediment eroded from the Road reaches the River.[179] On that basis, ICE concluded that the average input of sediment from the Road to the San Juan was 36,500 m^3 yr^{-1}, or 60,800 t y^{-1}.[180] This is to be contrasted with Dr Kondolf's estimate based on his observations, which is between 145,290 and 182,030 t y^{-1}.[181] The data analysed by Costa Rica's experts, including Professor Thorne, indicates that Dr Kondolf has over-estimated the sediment contribution from the Road to the River by a factor of 2.4 (taking Dr Kondolf's lower end of the range) to 3 (taking the upper end of Dr Kondolf's range). Professor Thorne has reviewed and analysed the methodology and results of Costa Rica's experts, and he concludes that their estimate is much more likely to be reliable than Dr Kondolf's estimate, which is significantly overstated.[182]

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175 **Vol 2, Annex No 6,** Andreas Mende and Allan Astorga G., *Inventory of Slopes and Water Courses related to the Border Road No 1856 between Mojón II and Delta Costa Rica*, October 2013 (the ***Inventory of Slopes and Water Courses***).

176 **Vol 2, Annex No 3,** Allan Astorga G. and Andreas Mende, *Route 1856: analysis of the change in land use based on satellite images before and after the construction of the border road*, August 2013 (the ***Land Use Change Report***).

177 **Appendix A**, Thorne Report, para. 8.44 and Table 13.

178 **NM, Annex 1**, 2012 Kondolf Report, p. 46.

179 **Appendix A**, Thorne Report, para. 8.45.

180 *Ibid*, para. 8.45 and Table 14.

181 *Ibid*, para. 8.49.

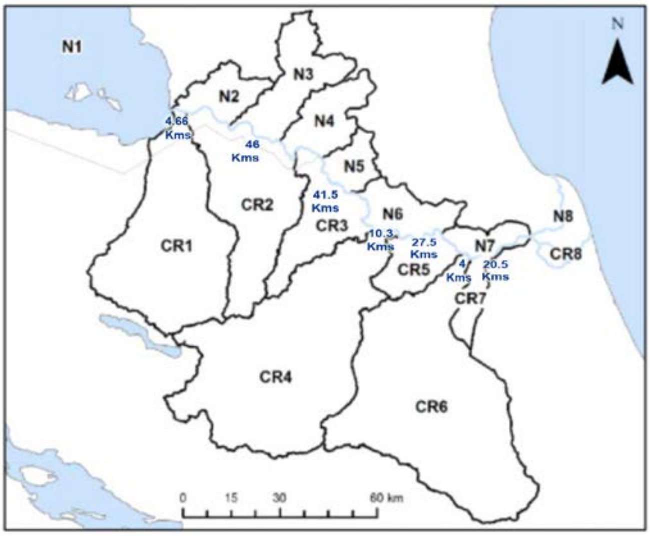
182 *Ibid*, para. 8.54.

3.26 ICE's analysis took account of reach relevant stretch of the 102 km of the Road. Their detailed results are reported in Table 14 and Figure 31 to the Thorne Report, reproduced here for convenience:

Table 14. Average annual inputs of Road-derived sediment to the Río San Juan (from the ICE Report)

Basin	Road length (km)	Input by volume (m^3 yr^{-1})			Input by mass* (t yr^{-1})		
		Road	Slopes	Total	Road	Slopes	Total
Major Costa Rican river basins draining directly to the Río San Juan between Marker II and Delta							
Infiernito	38	7 360	16 800	24 160	12 250	28 050	40 300
San Carlos	11	1 240	360	1 600	2 050	600	2 650
Cureña	28	3 140	4 540	7 680	5 200	7 600	12 800
Sarapiquí	3	340	100	440	550	150	700
Chirripó	22	2 460	160	2 620	4 100	250	4 350
Costa Rican area that drains directly to the Río San Juan between Marker II to and Delta Colorado							
Total	102	14 540	21 960	36 500	24 150	36 650	60 800

* To convert eroded volumes to masses, a bulk density of 1.67 t m^{-3} was assumed. This value is widely used to represent the bulk density of silt-sand soils.



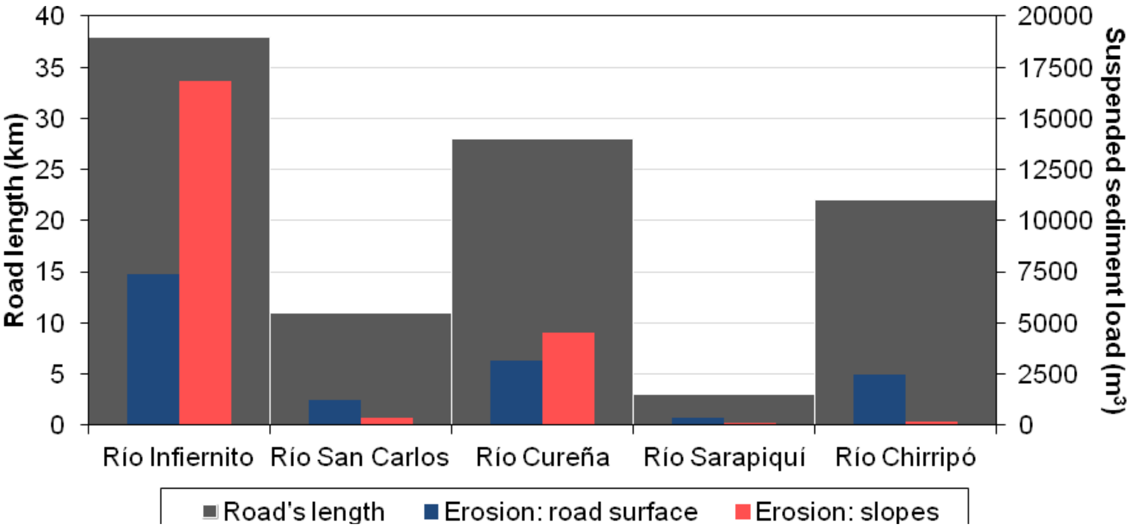


Figure 31 (a) Map showing the major tributary basins between Lake Nicaragua and Delta Costa Rica (b) Length of Road and estimated annual average inputs of sediment to the Rio San Juan from erosion of the road and cut/fill slopes in basins CR3 (Infiernito) to CR7 (Chirripó) between Marker II and the Delta (from 2013 ICE Report).

(3) Impact of the sediment eroded from the Road on the total sediment load of the River

3.27 As noted in paragraph 3.12 above, the total sediment load of a river is comprised of the suspended sediment load plus the bed load. In the period between December 2010 and June 2013, 115 bed load samples were collected by ICE at Delta Colorado and other samples were also collected at the mouths of the Río San Carlos and the Río Sarapiquí. On the basis of these samples, and using established methods to generate the bed load rating curve, ICE was able to estimate the average annual bed load in the Río San Juan. To the bed load, ICE added the suspended sediment load to estimate the total load. The results of their analysis are reflected in Table 6 of Professor Thorne's Report:

Table 6. Current average annual total loads in the Río San Juan - Colorado

River	Suspended load $t\ y^{-1}$	Bed load $t\ y^{-1}$	Total Load $t\ y^{-1}$
San Juan	6 573 000	2 559 000	9 133 000
Colorado	5 981 000	2 488 000	8 470 000
Lower San Juan	592 000	71 000	663 000

3.28 Thus the total sediment load in the Río San Juan is 9,133,000 $t\ y^{-1}$. In the Lower San Juan, it is 663,000 $t\ y^{-1}$.

3.29 As noted in paragraph 3.25 above, the average input of sediment to the Road is 60,800 $t\ y^{-1}$ annually.[183] This represents 0.67% of the total sediment load of the River. As Professor Thorne explains: "This is

183 **Appendix A**, Thorne Report, para. 8.45 and Table 14.

obviously too small a proportion to have any significant impacts on the River."[184]

3.30 As also noted in paragraph 3.25 above, Dr Kondolf's estimate of a range of sediment delivered annually from the Road to the River (145,290 and 182,030 t y^{-1} [185]) is significantly overstated. But even if it were an accurate assessment, which Costa Rica does not accept, it would represent only 1.6% to 2% of the total annual sediment load of the River. A contribution of sediment in this range is similarly too small to have any adverse impact on the River. As the Court noted in its Order of 13 December 2013 rejecting Nicaragua's Request for Provisional Measures in this case, a contribution of sediment in the order of 1 to 2 per cent of the total sediment load in the San Juan River "seems too small a proportion to have a significant impact on the river in the immediate future."[186]

(4) Impact of the sediment eroded from the Road on the bed in the Lower San Juan

3.31 Having established that the Road has not had any measurable impact on the sediment load of the San Juan River, Costa Rica's experts then considered the extent to which the Road is contributing sediment to the bed in the Lower Río San Juan. As noted in paragraph 3.28 above (and in Table 6 of the Thorne Report, reproduced above), the total sediment load in the Lower San Juan is 663,000 t y^{-1}. At Delta Colorado, the Río San Juan

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184 **Appendix A**, Thorne Report, para. 8.57.

185 *Ibid*, para. 8.49.

186 *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

branches between the Colorado River and the Lower San Juan: approximately 90% empties into the Colorado; and 10% to the Lower San Juan.

3.32 As noted in paragraph 3.25 above, the average input of sediment from the Road to the River is 60,800 t y^{-1} annually.[187] If 10% of this sediment enters the Lower San Juan, it would receive 6,080 t y^{-1} annually.[188] The Lower Río San Juan has a bed area of 2.7 million m^2. As Professor Thorne explains, taking account of the estimate of additional sediment and the area of the bed:

> "Supposing that <u>all</u> of this Road-related sediment were to be deposited on the bed of the lower Río San Juan (with none at all deposited on the floodplains and in the wetlands or passing through to the Caribbean Sea), the average increase in the rate of aggradation of the bed would be less than 0.2 mm y^{-1}."[189]

Even this "tiny increase" – which is less than the diameter of a single grain of sand – is an over-estimate. Because the Río San Juan is a sand bed river, only the sand fraction of the additional sediment would actually be likely to be deposited on the bed. Consequently, only 5 to 10% of the additional sediment would be deposited on the bed. Additional aggradation is therefore likely to be 0.02 mm y^{-1}. As Professor Thorne concludes:

> "It is immediately obvious that the addition of even the quantity of additional Road-derived sediment estimated by Dr Kondolf to the total annual sediment load of the lower Río San Juan could not have

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187 **Appendix A**, Thorne Report, para. 8.45 and Table 14.

188 *Ibid*, para. 8.58.

189 *Ibid*, para. 8.59.

impeded navigation or required Nicaragua to dredge the River for any purpose."[190]

(5) Potential impact of rainfall from a hurricane

3.33 Dr Kondolf asserts that erosion will likely be greater "during a tropical storm or hurricane",[191] and that in the region of the road "rainfall intensities can be very high, especially during tropical storms and hurricanes."[192] On the basis of Dr Kondolf's opinion, Nicaragua argues that the volume of sediment being delivered from the Road to the River will "increase dramatically".[193]

3.34 The region in which the Road is located has never been directly hit by a hurricane. This is confirmed by the map of historical hurricane tracks prepared by the United States National Ocean and Atmospheric Administration.[194]

3.35 Rainfalls in the region of the Road at the time of hurricanes to the north were unexceptional and were within the natural range of rainfall in the area, which is abundant. The Costa Rican National Meteorological Institute

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190 **Appendix A**, Thorne Report, para. 8.61. See also *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, paras. 34 (noting that the contribution of sediment in the order of 2 to 3 per cent in the lower San Juan River "seems too small a proportion to have a significant impact on the river in the immediate future", and that the Court has not been presented "with evidence as to any long-term effect on the river by aggradations of the river channel allegedly caused by additional sediment from the construction on the road").

191 **NM, Annex 1**, 2012 Kondolf Report, para. 6. See also para. 4.11.

192 *Ibid*, para. 4.7

193 NM, para. 4.19.

194 **Vol 3, Annex 13,** United States National Oceanic and Atmospheric Administration, Map of Historical Hurricane Tracks, available at http://csc.noaa.gov/hurricanes .

recorded rainfalls in the in the area proximate to the Road of between 20 and 250 mm (for Hurricane Joan); below 100 mm (for Hurricane Mitch); and between 15 and 150 mm (for Hurricane Stan).[195] Rainfalls in such measures are unlikely to cause a dramatically increased quantity of sediment to be delivered to the River. As Professor Thorne explains:

> "In my opinion, rainfalls of this magnitude were in each event unexceptional and unlikely to cause widespread destruction because the basin of the Río San Juan receives abundant rainfall in most years and the hydrology, sediment dynamics, morphology and environment of the River are fully adjusted to the effects of frequent and heavy rainstorms."[196]

But even if a disastrous hurricane of the sort Nicaragua foretells did impact the region, the last thing people would be worrying about was sediment from the road. Likewise, sediment from the entire basin would increase in the same proportions, and any impact to the river would be caused by the overall catastrophe, and not by the road alone.

(6) The Road has had no adverse impact on sediment in the River

3.36 The scientific and independent expert evidence submitted by Costa Rica demonstrates that the Road has had no adverse or significant impact on the sediment load of the River. Professor Thorne expresses his opinion as follows:

> "The Road has had no significant impacts on sediment transport and dynamics in the Rio San Juan because the additional loads of sediment are tiny (less than 1%) compared to natural loads and are

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195 **Vol 3, Annex 68,** Letter from the General Director of the Costa Rican National Meteorological Institute to H.E. Edgar Ugalde Álvarez, 7 November 2013.

196 **Appendix A**, Thorne Report, para. 6.20.

well within the ranges of natural variability (+/-20%) characteristic of this River, meaning they are in practice indiscernible."[197]

3.37 In his Third Report, submitted to the Court in support of Nicaragua's Request for Provisional Measures in November 2013, Dr Kondolf reports that he measured suspended sediment concentrations (***SSCs***) in three samples of muddy–water in plumes in the River, which had entered the River following a 15-minute downpour. These three samples had SSCs of 364, 459 and 483 grams per cubic metre, which Dr Kondolf described as "high".[198] He compared these to two samples of water from the San Juan, which had SSCs of 8 grams per cubic metre.[199] He stated that this confirmed "via laboratory analysis what is obvious from the eye: that the runoff from the road carried high suspended sediment contributions."[200]

3.38 The two samples of River water analysed by Dr Kondolf – which he used as his baseline to measure the impact of the runoff from the Road – have unusually low SSCs when considered in the context of 2,409 samples analysed by Costa Rica's experts, which generally ranged between 10 and 10,000 grams per cubic metre.[201] As Professor Thorne observes:

> "While the background SSC in the River as measured by Dr Kondolf was indeed low, the concentrations in the plume of muddy-water are not high in the context of SSCs routinely observed in runoff draining to the Río San Juan, or even in the River itself."[202]

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197 **Appendix A**, Thorne Report, para.12.2.

198 Third Kondolf Report, p. 11; see also Figure 5 on p. 12.

199 *Ibid*, p. 11.

200 *Ibid*.

201 **Appendix A**, Thorne Report, para. 10.5.

202 *Ibid*.

3.39 Furthermore, while intense concentrated rainstorms are likely to produce a contrast between local runoff and the receiving water, due to the River's natural processes and movement, "the *relatively high* SCCs decrease to background levels within a short distance downstream and a short time after the rainstorm ends, as the plume of local runoff diffuses into the far greater flow in the receiving water."[203]

3.40 In his Fourth Report, Dr Kondolf altered his position somewhat on the results of his analysis: he accepted that the concentrations he measured in the muddy-water plume "were not very high compared to concentrations measured in the river and its large tributaries during high flows", but maintained that the measurements "demonstrate the essential fact that sediment from the road is entering the Río San Juan."[204] But of course that does not evidence any adverse impact on the San Juan. As Professor Thorne observes:

> "… the central point remains this: in order to assess whether the concentrations of suspended sediment measured in runoff from the Road have harmed or may in future cause harm to life in the River, it is necessary to consider them within the context of sediment concentrations that aquatic plants and animals in the river system experience routinely and to which they are well adapted. The analysis conducted herein demonstrates that concentrations often exceed 500 grams per cubic metre and so those measured in May 2013 (364, 459 and 483 grams per cubic metre) have not, and will not damage life in the River."[205]

3.41 The evidence submitted by Costa Rica further demonstrates that the Road has had no adverse or significant impact on the lower Río San Juan,

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203 **Appendix A**, Thorne Report, para. 10.6.

204 Fourth Kondolf Report, p. 11.

205 **Appendix A**, Thorne Report, para. 10.7.

including by aggradation of the bed of the River. As Professor Thorne concludes:

> "Sediment transfer and deposition calculations based on measured data and conservative assumptions demonstrate that the additional amount of Road-derived sediment entering the lower Río San Juan is probably less than 1% of its total sediment load.
>
> Sediment continuity dictates that even if all of this sediment were to be deposited on the bed of the channel, it would on average raise the bed of the river by less than 0.2 mm per year. In fact, deposition is spread over a much wider area of floodplain, wetlands and wash lands and an unknown but significant percentage of the load is discharged to the Caribbean Sea. Also, as the River has a sand bed, it is likely that only the sand fraction (which makes up 5 to 10% of the Road-derived sediment delivered to the River) would actually be deposited on the bed. Hence the estimates of increase sediment load and bed deposition in the lower Río San Juan are necessarily over-estimates. They are in any case well within the error margin for sediment measurements and calculations, and are small in comparison to inter-annual fluctuations in that are the product of natural variability."[206]

3.42 As noted in paragraph 3.5 above, Nicaragua's claims as to the significant harm which it alleges is being caused to the River are based on the contribution of sediment from the Road to the River. In the circumstances that this sediment contribution is insignificant and indiscernible, Nicaragua's claims must fail. As Professor Thorne notes:

> "Due to very small relative contribution of sediment in comparison to the heavy and highly variable sediment load in this River, the Road has not and will not in future pose a risk of harm to the hydrology, sediments, morphology, environment, or ecology of the

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206 **Appendix A**, Thorne Report, paras. 12.5-12.6.

River, all of which are well-adapted to the heavy load and highly variable sediment regime of the Río San Juan.[207]

C. There is No Risk of Any Other Adverse Impact on the San Juan River

3.43 Nicaragua claims that the Road has had an adverse impact on the San Juan River in respect of (1) water quality; (2) channel morphology; (3) navigation; and (4) ecosystem, tourism and health. The extent to which the Road is having such an adverse impact on each of these issues will now be addressed.

3.44 Before doing so, it is necessary to mention Nicaragua's misplaced emphasis on the question whether the Road was constructed with strict adherence to engineering standards. Nicaragua relies heavily on two reports produced in Costa Rica: a May 2012 report of the National Laboratory of the University of Costa Rica (in its Spanish acronym, ***LANAMME***)[208] and a June 2012 report of the Costa Rican Federated Association of Engineers and Architects (the ***CFIA***).[209] It alleges that these reports support its claim that the Road has caused environmental harm to the San Juan River.[210] When reviewed carefully, it is apparent that the reports of LANAMME and the CFIA do not evidence that environmental harm has or will be caused to the San Juan River. Both LANAMME and CFIA have confirmed that their

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207 **Appendix A**, Thorne Report, para. 12.7.

208 **NCM, Annex 3,** National Laboratory of Materials and Structural Models of the University of Costa Rica, "Report INF-PITRA-014-12: Report from Inspection of Route 1856 - Juan Rafael Mora Porras Border Road," May 2012.

209 **NCM, Annex 4**, Federated Association of Engineers and Architects of Costa 257 Rica, "Report on Inspection of the on the Border Road, Northern Area Parallel to the San Juan River CFIA Report," 8 June 2012.

210 See, e.g, NM, paras. 2.26, 3.4-3.5, 3.15-3.18, 3.20, 3.24, 3.26-3.28, 3.34-3.36, 3.40, 3.43, 3.45-3.46, 3.50, 3.52, 3.55-3.56, 4.15, 5.11, 5.100, 5.106, 6.7, and 6.21.

reports do not address the impacts of the Road on the San Juan River. They furthermore indicate that their reports have been misrepresented by Nicaragua.[211]

3.45 Costa Rica has explained in Chapter 2 above the emergency circumstances in which the Road was constructed, necessitating the implementation of solutions of a temporary character which provided provisional access to towns and locations along the border that had no other viable means of access. This was done in case such access became urgently necessary in view of the situation of national emergency created by Nicaragua. Costa Rica has also explained in Chapter 2 that, since April 2012, work has been carried out to protect the Road and to mitigate the effects of the Road, primarily in Costa Rican territory. That work is continuing, and Costa Rica is committed to completing the Road to the highest environmental and engineering standards. Whether or not the Road was initially constructed to such standards is beside the point: Nicaragua's claim is that Costa Rica has breached its international obligations because the Road is causing environmental harm to Nicaragua's territory, and in respect of that claim, Nicaragua bears the burden of proof to show such harm. In the absence of any evidence of adverse impact to the River, it has completely failed to discharge that burden.

3.46 Nicaragua's reliance on press reports referring to an extract of the administrative file of a proceeding before Costa Rica's Administrative Environmental Tribunal (***TAA***, in its Spanish acronym) is similarly

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[211] See **Vol 3, Annex 63**, Letter from the President of the CFIA to the Minister of Foreign Affairs of Costa Rica, Reference 034-2012-2013-PRES, 28 August 2013; **Vol 3, Annex 61**, Letter from LANAMME to the Minister of Foreign Affairs of Costa Rica, Reference LM-IC-0914-2013, 14 August 2013.

misplaced.[212] Nicaragua asserts that this Tribunal confirmed that the Road had caused environmental harm.[213] This is incorrect. As explained by the President of the Administrative Tribunal, the file to which the press report refers is a note signed by a single employee of the technical department of the Tribunal. It is not a decision of the Tribunal. Furthermore, the note in question states that there was no actual or potential damage to Nicaraguan territory, so it does not confirm that the Road has caused environmental harm to Nicaragua.[214]

(1) Water quality

3.47 Nicaragua claims that the contribution of sediment from the Road to the River has adversely impacted the water quality of the River.[215] It relies on the view expressed by Dr Kondolf that increased sedimentation affects water quality.[216] Nicaragua claims compensation for the cost of restoring the water quality of the San Juan.[217]

3.48 As Costa Rica has demonstrated, the Road is not delivering additional sediment to the River in excessive concentration or any measurable quantity which would cause any harm to the River, including in respect of water quality. Professor Thorne concludes that "[t]here is absolutely nothing to suggest that the Road has adversely impacted the

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212 **NCM, Annex 37**, El Pais, Costa Rica, "Environmental Court Confirms Excessive Felling in the Construction of Trail 1856", 15 July 2012.

213 NCM, paras. 5.13, 5.19 and 5.21.

214 **Vol 3, Annex No 51**, Note from President of the TAA to Foreign Minister of Costa Rica, Reference 200-13-TAA, 9 April 2013.

215 NM, paras. 3.60, 3.81, 3.89 and 3.92.

216 **NM, Annex 1**, Kondolf 2012 Report, para. 1.3.2.

217 NM, para. 6.33.

water quality" of the San Juan.[218] As the Court noted in its Order of 13 December 2013 rejecting Nicaragua's Request for Provisional Measures in this case, "Nicaragua has not established in the current proceedings that the ongoing construction works have led to a substantial increase in the sediment load in the river."[219] It observed further that "the photographic and video evidence submitted by Nicaragua does nothing to substantiate Nicaragua's allegations relating to increased sedimentation levels."[220] Nicaragua's claims as to adverse impact on water quality of the River fail.

(2) Morphology

3.49 Nicaragua contends that Costa Rica's alleged failure to apply certain design and construction standards, including "international road practices intended to minimize on-site and off-site impacts to [*inter alia*] channel morphology" has "resulted in the deterioration of the Road itself and adverse impacts on neighboring watercourses, including the San Juan River."[221] Dr Kondolf was more measured about potential impacts on morphology, making only a very general statement that "[h]ydrologic connectivity [such as that between Costa Rican tributaries and the San Juan] greatly accelerates man-caused sediment delivery to off-site, downstream areas and *can* seriously impact channel morphology and aquatic habitat"[222] and that sediment "*could* impair downstream river morphology or

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218 **Appendix A**, Thorne Report, para.12.4.

219 *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

220 *Ibid*.

221 NM, para 3.6.

222 **NM, Annex 1**, 2012 Kondolf Report, p. 37, para. 4.9 (emphasis added).

ecology."[223] Nicaragua submitted no evidence to support its assertion that the Road has had or is likely to have an impact on the morphology of the San Juan River. To the extent that such an assertion is based on the contribution of sediment from the River, it has been established by Costa Rica's expert evidence and confirmed by Professor Thorne that there has been no significant impacts on sediment transport and dynamics in the River because the additional contributions to the sediment load are "tiny" and, within the context of this River, "indiscernible".[224]

3.50 In his 2012 Report, Dr Kondolf included photographs of sediment deltas which he says he observed on the Costa Rican side of the River, and which he attributed to the Road.[225] As Professor Thorne notes, these photographs do not demonstrate that the Road is having any significant morphological impact on the River; indeed, they confirm that the Road is morphologically insignificant.[226] As the Court noted in its Order of 13 December 2013 rejecting Nicaragua's Request for Provisional Measures in this case, "the photographic and video evidence submitted by Nicaragua does nothing to substantiate Nicaragua's allegations relating to increased sedimentation levels."[227]

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223 **NM, Annex 1**, 2012 Kondolf Report, p. 50, para. 5.6 (emphasis added).

224 **Appendix A**, Thorne Report, para. 12.2.

225 See **Appendix A**, Thorne Report, Figure 35, reproducing photographs from Appendix B to 2012 Kondolf Report.

226 **Appendix A**, Thorne Report, para. 9.1.

227 *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

3.51 Moreover, as Professor Thorne observed in his comprehensive site visits to the Road and his overflight of the relevant area, there are also multiple deltas of sediment on the Nicaraguan side of the River.[228] This demonstrates, in Professor Thorne's expert opinion, that "deltas in this River are not exclusively or even predominantly caused by deposition of additional sediment eroded from the Road."[229] Moreover, the mere presence of deltas does not demonstrate that the Road has adversely impacted channel morphology, nor that there has been any other adverse impact – indeed, deltas may be beneficial to the ecosystem. As Professor Thorne notes:

> "… deltas are part of the natural sediment transfer system along the channel of the Río San Juan. They form when local rainstorms produce sediment-laden runoff from tributaries, the coarse fraction of which is deposited in the lower course of the tributary channel and around the tributary's confluence with the Río San Juan. As Dr Kondolf notes, that deposition is temporary – deltaic sediments are re-eroded and transported downstream, diffusing into the receiving river's sediment load during the next significant sediment transport event in the main river.
>
> In any case, the limited size and relatively wide spacing of the tributary deltas I observed along both banks of the Río San Juan in May 2013 means that they do not harm the River. Indeed, to the contrary, tributary bars and deltas are beneficial to the aquatic and riparian ecosystems because, for example, they provide fresh habitats and open niches for pioneer plant species – for example, as illustrated in photographs 1018, 1043 and 1046 in Dr Kondolf's 2013 **Appendix A** (to his Third Report)."[230]

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228 **Appendix A**, Thorne Report, para. 9.6; see also Figures 36-38.

229 *Ibid*, para. 9.7.

230 *Ibid*, paras. 9.8-9.9.

3.52 Professor Thorne concludes that the Road has not posed and will not pose any risk of harm to the morphology of the River.[231] It follows that Nicaragua's claim to the contrary must be dismissed.

(3) Navigation

3.53 Nicaragua claims that the road works have breached Nicaragua's right of navigation on the San Juan River.[232] In support of this claim Nicaragua refers to two annexes. The first is the report of Dr Kondolf, which in its introduction to Appendix B (which consists of photographs) states as follows:

> "These selected photographs document major deficiencies by Costa Rica in abiding by international road practices intended to minimize on-site and off-site impacts to water quality, channel morphology, navigation and riverine ecology…"[233]

Apart from this single reference alleging deficiencies in practices which are intended to minimize impacts to navigation, there is no further discussion of any impact on Nicaragua's ability to navigate on the San Juan in Dr Kondolf's lengthy reports. This isolated statement is demonstrably insufficient to establish that Nicaragua's ability to navigate on the San Juan has been impacted at all by the road infrastructure works.

3.54 The second document which Nicaragua cites in support of its claim that Costa Rica has breached Nicaragua's right of navigation is a note from Nicaragua's Minister of Foreign Affairs to the Costa Rican Minister of

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231 **Appendix A**, Thorne Report, para. 12.7.

232 NM, para. 4.41. See also para. 6.15.

233 **NM, Annex 1**, Appendix B, p 1, referred to in para. 3.6, footnote 112.

Foreign Affairs dated 10 December 2011.[234] In that letter, the Nicaraguan Minister asserts that dumping of trees and soil "into the river flow, difficulting [*sic*] and risking the navigation in its waters".[235] This is mere assertion and does not demonstrate the existence of harm. In addition, Nicaragua's own documents show that its officials ply the river regularly without problem.[236]

3.55 For the reasons explained in paragraph 3.32 above, even on the most conservative estimates aggradation of the bed due to the sediment derived from the Road would occur at a rate of less than 0.2 mm y^{-1}. This "could not have impeded navigation or required Nicaragua to dredge the River for any purpose."[237] Nicaragua's claim in this regard must be dismissed.

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234 **NM, Annex 16**, Diplomatic note from the Minister of Foreign Affairs of 401 Nicaragua to the Minister of Foreign Affairs of Costa Rica, Reference MRE/DVS/VJW/0685/12/11, Managua, 10 December 2011.

235 *Ibid*, referred to in NM, para. 2.31.

236 **Vol 3, Annex 18,** Letter to the Registrar of the Court from H.E. Carlos Argüello Gómez, Agent of the Republic of Nicaragua, 31 Oct. 2013, Ref. HOL-EMB-220, Ann. 1, Technical Waterway Patrol on the San Juan River on 27 Oct. 2013, Ministry of Environment and Natural Resources (MARENA), San Juan River Territorial Delegation. Also see **Vol 3, Annex 12**, Photographs of transport of passengers and other Nicaraguan navigation on the San Juan River.

237 **Appendix A**, Thorne Report, para. 8.61. See also *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34 (noting that the Court has not been presented "with evidence as to any long-term effect on the river by aggradations of the river channel allegedly caused by additional sediment from the construction on the road").

(4) Ecosystem, Tourism and Health

3.56 Nicaragua makes three further claims as to the impact of the road infrastructure works on the San Juan River, as to adverse effects on the ecosystem, tourism and health of the riparian communities of the River.

3.57 First, Nicaragua alleges that the Road has harmed the ecosystem of the River.[238] As a consequence of that harm, Nicaragua claims compensation for losses allegedly suffered in respect of fishing.[239] Nicaragua's primary source of evidence for damage to the ecosystem of the San Juan is the judgment of the Central American Court of Justice. For the reasons explained in **Section D** below, the findings of that Court cannot be relied upon.

3.58 Nicaragua attempts to find support of this claim in the evidence of Dr Kondolf. He attests that increase sedimentation on a river can cause significant ecological damage. He notes that "[t]hese effects have been documented in multiple sites around the globe in a wide range of ecosystems."[240] While that might be true at an abstract level, Dr Kondolf does not document any such effects in respect of the San Juan.

3.59 In his Third Report, submitted in support of Nicaragua's Request for Provisional Measures, Dr Kondolf reported results of sampling of periphyton done by his colleague, Dr Rios, at nine sites, in May 2013.[241] The samples collected from the sites on the Costa Rican bank of the River

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238 NM, para. 3.93. See also paras. 1.9-1.10, 5.61 (referring to Nicaragua's report to the Court dated 23 July 2012 in the *Certain Activities* case), and 5.67.

239 NM, para. 6.33.

240 **NM, Annex 1**, 2012 Kondolf Report, para 3.1.5. See also para 3.1.4.

241 Third Kondolf Report, p. 13.

were said to have a lower periphyton biomass than those collected from the sites on the Nicaraguan bank of the River.[242] This was said by Dr Kondolf to be "one indication of the negative ecological effects of sediment eroded from Rte 1856 upon the Río San Juan."[243] As Professor Thorne pointed out in his report submitted in response to this evidence during the oral hearings, there is no indication in Dr Kondolf's analysis as to whether the sites sampled from the Nicaraguan side of the River were on any of the multiple deltas he observed there in May 2012; hence it is not possible to know whether the samples were comparable to those from the Costa Rican deltas.[244] Dr Kondolf did not respond to this criticism in his responsive report submitted during the Provisional Measures hearing; nor did he provide any information as to the location where the Nicaraguan samples were taken.[245] In the circumstances, it is apparent that this sampling exercise provides no evidence of any adverse impact on ecology.[246] In any event, Dr Kondolf refers to this as merely "one indication"; but it is apparent that he refers to no other factors confirming negative ecological impact. As the Court noted in its Order of 13 December 2013 rejecting Nicaragua's Request for Provisional Measures in this case, "with respect to the alleged effect on the ecosystem including individual species in the river's wetlands, the Court finds that Nicaragua has not explained how the road works could

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242 Third Kondolf Report, p. 13 and Figure 6.

243 *Ibid*, p. 13.

244 **Vol 2, Annex No 9,** Professor Colin Thorne, *Report on the Risk of Irreversible Harm to the Río San Juan relating to the Construction of the Border Road in Costa Rica*, 4 November 2013, p. 36.

245 Cf Fourth Kondolf Report.

246 See **Appendix A**, Thorne Report, para. 10.12.

endanger such species, and that it has not identified with precision which species are likely to be affected."[247]

3.60 In the Environmental Diagnostic Assessment undertaken by CCT, the impacts and potential impacts of the Road on terrestrial and aquatic environments and ecosystems were comprehensively investigated.[248] CCT's Report covered the Road's environmental and ecological impacts on Costa Rican territory, and concluded that these impacts were irrelevant in five of eight categories and moderate in the remaining three categories. The moderate impacts were principally restricted to the stretch of Road between Marker II and Boca San Carlos, which, as noted in paragraph 3.17 above, is the only part of the Road of which Dr Kondolf complains. Moderate impacts were limited to cutting of trees, and increased turbidity and disturbance of micro-habitats in some Costa Rican water bodies, due to local and confined inputs of sediment.[249]

3.61 In respect of impacts on Nicaraguan territory, CCT noted that it was not permitted to enter Nicaraguan territory to conduct sampling and to investigate potential impacts.[250] However, based on the field research and monitoring that CCT was able to undertake, it concluded that "it is not considered there could be any significant impact on the San Juan river."[251] In coming to this conclusion, CCT took into account that sediment transport

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[247] *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

[248] See **Appendix A**, Thorne Report, para. 10.15.

[249] **Vol 2, Annex No 10,** CCT Report, para 6.2.3; **Appendix A**, Thorne Report, para. 10.15.

[250] **Vol 2, Annex No 10,** CCT Report, p. 13.

[251] *Ibid*, para. 6.3.2.

and sedimentation are part of the natural processes of a river, and that sediment performs important and beneficial functions in tropical water bodies such as the San Juan. It also took account of the fact that species of macro-invertebrates and fish in the San Juan are adapted to conditions of high and variable sediment loads and have high tolerance to these. Finally, it noted that the large volume of water in the River, its depth and capacity and the high degree of adaptability of aquatic organisms therein suggest that impacts would not be felt even at an insignificant level.[252]

3.62 Secondly, Nicaragua claims that the construction of the road has caused "substantial harm to the scenic value and eco-tourism potential of the San Juan River".[253] It asserts that the construction of the road "has probably eradicated all the area's attractiveness to ecotourists".[254] It claims compensation for losses allegedly suffered "in the sector of tourism".[255]

3.63 Nicaragua has not produced any evidence demonstrating that the Road has had an impact on tourism. Its annexes contain only one reference to the impact on tourism, in a press article published in a Nicaraguan newspaper, which asserts that "tourists make faces when they see the road."[256] This single impressionistic piece of anecdotal evidence is demonstrably insufficient to demonstrate that the road has caused harm to Nicaragua, let alone harm which would sustain a claim to compensation.

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252 **Vol 2, Annex No 10,** CCT Report, Chapter 6; see also **Appendix A**, Thorne Report, para. 10.18.

253 NM, para. 4.1 See also para. 1.12;

254 NM, para. 5.104.

255 NM, para. 6.33.

256 NM, Annex 26, p. 448.

3.64 CCT, in the Environmental Diagnostic Assessment, comprehensively considered potential impacts of the Road on tourism and concluded that there were no direct impacts. As noted by CCT[257] and by Professor Thorne,[258] there are no facilities for tourists on either bank of the River between Marker II and Delta Costa Rica, i.e. adjacent to the 108 km stretch of the Road along the San Juan River. Furthermore, the potential for tourism is low, due to lack of accommodation and infrastructure, difficulties of access and perceptions of instability in the border area. CCT concluded that "[t]he effect of the construction of Route 1856 has no direct impact on tourism in recent years."[259]

3.65 Finally, Nicaragua claims that the construction of the Road has impacted upon the health of the riparians of the River. Although this claim is not articulated with any particularity, it appears to be based on the assertion that adverse impacts on the River will necessarily have an adverse impact on the health of riparians.[260] In its Request for Provisional Measures, Nicaragua made a similar assertion, that the Road was causing "irreparable damage" to "the health and wellbeing of the population living along [the]

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257 **Vol 2, Annex No 10,** CCT Report, para. 7.1.3.14.

258 **Appendix A**, Thorne Report, paras. 10.20-10.21.

259 **Vol 2, Annex No 10,** CCT Report, p. 148 (conclusion 14).

260 NM, para. 2.14. Nicaragua cites to two sections of Dr Kondolf's 2012 Report (see NM, para. 6.33, footnote 609, referring to sections 3.1.4 and 4.5 of the 2012 Kondolf Report). However, neither those sections, nor any other part of Dr Kondolf's Report deal with the impacts on the Road on human health.

margins [of the River]”,[261] but this claim was not substantiated in any way, and it appeared to abandon it.[262]

3.66 For the reasons explained above, the Road has not had any adverse impact on the River. Nicaragua has not provided any evidence to the contrary; nor has it presented any evidence showing a causal connection between health of the River and health of human communities in proximity to the River. This claim must therefore fail also.

D. The “Judgment” of the CACJ Should be given No Weight

3.67 Nicaragua’s Memorial is permeated with references to a judgment of the Central American Court of Justice of 21 June 2012 (the ***CACJ “Judgment”***). This is one of the main sources of “evidence” Nicaragua relies upon to demonstrate that the Road has caused any harm to the San Juan River.[263] However, the CACJ Judgment should not be taken into account by the Court, because the CACJ did not have any jurisdiction, Costa Rica did not therefore participate in the proceedings, and what is more, the “Judgment” was based on no scientific evidence of harm whatever.

3.68 The CACJ is not the same body which gave a decision on Costa Rica’s treaty rights in 1916. It is a new body, intended to form part of the

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261 **Vol 3, Annex No 67,** Letter from Agent of Nicaragua to the Registrar of the International Court of Justice, Reference HOL-EMB-196, 11 October 2013, p. 3.

262 See CR 2013/31, p. 16, para. 3 (Wordsworth) and p. 33, para. 30 (Wordsworth); see also CR 2013/29, p. 42, para. 21 (Wordsworth). None of Nicaragua’s counsel mentioned the word “health” in their oral submissions.

263 NM, paras. 2.41, 2.45-2.46, 3.11, 3.61-3.62, 3.64, 4.16, 5.4, 5.40, 5.43, 5.62-5.63, 5.107, and 5.108.

Central American Integration System. The Central American Integration System was created in 1991.[264]

3.69 It is a fundamental principle of international law that judicial authority may only be exercised over States with their consent. This principle is reflected, for example, in Article 36(1) of the Statute of the ICJ, which provides:

> "The jurisdiction of the Court comprises all cases which the parties refer to it and all matters specially provided for in the Charter of the United Nations or in treaties and conventions in force."[265]

3.70 Costa Rica is not a party to the Statute of the CACJ. In 1995 Costa Rica's Parliament voted against ratification of the CACJ Statute.[266] The fact that Costa Rica is not subject to the jurisdiction of the CACJ was recalled by Costa Rica's Foreign Minister by note dated 30 April 2009.[267] That Costa Rica is not a party to the CACJ Statute is recorded on the CACJ's website.[268] Thus the CACJ has no jurisdiction to decide any dispute involving Costa Rica. In the absence of Costa Rica's consent, the CACJ's "Judgment" has no effect in relation to Costa Rica.

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264 See Tegucigalpa Protocol to the Charter of the Organization of Central American States (ODECA), Tegucigalpa, 13 December 1991, 1695 *UNTS* p. 382.

265 Statute of the ICJ, Article 36(1).

266 **Vol 3, Annex No 20,** Costa Rica, Permanent Commission on Legal Matters, Majority Negative Vote, Bill for Approval of the Statute of the Central American Court of Justice signed in Panama City, Panama on 1 December 1992, File Number 11.854, 5 December 1998.

267 **Vol 3, Annex No 33,** Note from Foreign Minister, Costa Rica, to CACJ, Reference DM-AM-306-09, 30 April 2009; see also **Vol 3, Annex No 14,** Costa Rican Ministry of Foreign Affairs, Press Release, 5 May 2009.

268 See **Vol 3, Annex No 73**, Extract from CACJ website, "The challenge is having Panama and Costa Rica join", available at http://portal.ccj.org.ni/ccj2/Publicar/tabid/88/EntryId/3/-El-reto-es-que-Panama-y-Costa-Rica-se-integren.aspx .

3.71 As Costa Rica has not consented to the jurisdiction of the CACJ, Costa Rica did not participate in the proceedings.

3.72 The CACJ "Judgment" was not based on any scientific evidence. The CACJ "Judgment" does not refer to such evidence in relation to the harm allegedly caused by the construction of the Road. It records that the Judges participated in a site visit to the San Juan River.[269] It states that, during this visit, the Court was able to "verify the damage to the bank" and the absence of "general buffering measures", as well as the proximity of the road to the River "which makes *possible* a landslide … with the resulting sedimentation that would pollute the river".[270] Leaving to one side these impressions, which are in any event misconceived (sediment is not pollutant, and is not impacting the River), the Judgment refers to no other evidence – scientific or otherwise – for the conclusion that the Road has caused any harm to the San Juan River.

3.73 As a further and separate point, it is noted that the CACJ has conducted itself in such a way as to give rise to a perception of bias. This confirms that the "Judgment" should be given no effect by this Court. Initially, the President of the CACJ appeared to encourage Nicaragua to commence proceedings against Costa Rica.[271] Soon thereafter, a proceeding was filed by organizations which have close links to the Sandinista

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269 **NCM Annex 13**, CACJ Judgment, 21 June 2012, p. 4, para. IX.

270 *Ibid*, p. 19, para. XXVI (emphasis added).

271 **Vol 3, Annex No 74,** El Nuevo Diario, (Nicaragua), "Stop the Road", 30 November 2011, available at http://www.elnuevodiario.com.ni/nacionales/234697-paren-carretera ("… the president of the Central American Court of Justice, CACJ, Francisco Lobo, said yesterday that the dispute provoked by the southern neighbour's decision to build a road along the river, can be solved in that regional body").

Government.[272] One of these organizations is headed by Nicaragua's Presidential Adviser for the Environment, who has the rank of Minister. Within two weeks, the President of the Court announced to the Nicaraguan Press that the Court could make a site visit and issue provisional measures, and that if Costa Rica failed to comply with the Court's order, it would be declared in breach.[273] Within a week of the site visit, the CACJ issued a provisional measures order.[274]

3.74 After the provisional measures order, the President of the CACJ made further public statements that could be seen as encouraging the claimants to present sufficient evidence to make good the claims against Costa Rica. The Nicaraguan press recorded that the President "called Nicaraguan environmental organizations to present sufficient evidence so that the Court did not render a judgment … without merit."[275]

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272 **Vol 3, Annex No 75**, Radio La Primerísima, "Central American Court admits lawsuit against Costa Rica", 19 December 2011, available at http://www.rlp.com.ni/noticias/111936/corte-ca-admite-demanda-contra-costa-rica ; **Vol 3, Annex No 29**, Appointment of Jaime Incer Barquero as Nicaragua's President Adviser on the Environment, with rank of Minister. Presidential Decree 88-2009, of 2 April 2009, published in Nicaragua's Official Gazette No. 65, of 3 April 2009.

273 **Vol 3, Annex No 75,** Radio La Primerísima, "CA Court Admits Complaint Against Costa Rica", 19 December 2011, available at http://www.rlp.com.ni/noticias/111936/corte-ca-admite-demanda-contra-costa-rica ("[President of the CACJ] Lobo said that a delegation of judges of the CACJ could make a visit to the area in which Costa Rica builds its road, to ascertain the environmental damage that the project could be causing, and thus define the precautionary measures to be imposed to the neighbouring country. Should Costa Rica dismiss the decision of the CACJ, [President] Lobo said it could be declared 'rebel'…").

274 Referred to in **NCM Annex 13**, CACJ Judgment, 21 June 2012, p. 10, para. IX.

275 **Vol 3, Annex No 76,** El Nuevo Diario, "CACJ opens trial to evidence", 24 January 2012, available at http://www.elnuevodiario.com.ni/politica/239562 .

3.75 After the CACJ Judgment was issued, Nicaragua was quick to announce that it would be used as evidence before the ICJ.[276] In these circumstances, it is hardly surprising that it forms a centrepiece of Nicaragua's Memorial. But for the reasons explained, it cannot be given any weight by this Court.

276 **Vol 3, Annex No 77,** El 19 Digital, "Nicaragua advances in collecting evidence for case against Costa Rica in The Hague", 10 February 2012, available at: http://www.el19digital.com/index.php?option=com_content&view=article&id=35619:nicaragua-avanza-en-recopilacion-de-pruebas-para-juicio-en-la-haya-contra-costa-rica&catid=23:nacionales&Itemid=12 ; **Vol 3, Annex No 78,** La Prensa (Nicaragua), "CACJ Judgment will go to case at The Hague", 3 July 2012, available at http://www.laprensa.com.ni/2012/07/03/ambito/107181-fallo-ccj-a-al . See also **Vol 3, Annex No 79,** La Prensa (Nicaragua), "Damages to the river will be quantified", 3 November 2013, available at http://www.laprensa.com.ni/2013/11/03/poderes/168532-cuantificaran-danos-al-rio .

E. Conclusion

3.76 Nicaragua's claims of significant harm rest on its assumption that the Road is contributing sediment to the River in quantities which cause damage. Costa Rica's evidence demonstrates that this is not the case. In particular,

(a) The sediment load carried by the San Juan in the period since construction of the Road is actually *lower* than it was before the Road was constructed. Hence, there is no evidence that construction of the Road has increased the suspended sediment load carried by the San Juan.

(b) The field monitoring undertaken by Costa Rica's experts indicates that the average input of sediment from the Road to the River is 60,800 t y^{-1} annually. This represents 0.67% of the total sediment load of the River, and is obviously too small a proportion to have any significant or adverse impact on the River. This is consistent with the Court's conclusion in its Order of 13 December 2013 rejecting Nicaragua's Request for Provisional Measures, in which it noted that a contribution of sediment in the range of 1 to 2 per cent of the total sediment load of the San Juan River "seems too small a proportion to have a significant impact on the river in the immediate future."[277]

[277] *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

(c) At Delta Colorado, 10% of the San Juan enters to the Lower San Juan River. It is reasonable to assume that 10% of the additional sediment would enter the Lower San Juan (i.e 6,080 t y^{-1} per year). Taking account of the bed area of the Lower San Juan, the average increase in the rate of aggradation of the bed would be less than 0.02 mm y^{-1} – less than the diameter of a single grain of sand. This could not have impacted navigation or caused Nicaragua to have to dredge the River. As the Court noted in its Order of 13 December 2013, the Court has not been presented "with evidence as to any long-term effect on the river by aggradations of the river channel allegedly caused by additional sediment from the construction on the road."[278]

(d) As the Road is not delivering additional sediment to the River in excessive concentration or any measurable quantity which would cause any harm to the River, there is no evidence to suggest that there has been any adverse impact on the water quality of the San Juan.

(e) There has been no harm to the River in terms of channel morphology.

(f) There is no evidence of any adverse impact on the ecosystem, nor on tourism or health of riparians.

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278 *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 34.

Chapter 4

The Treaty of Limits has no Bearing on the Present Proceedings

A. Introduction

4.1 In its Memorial, Nicaragua lists the 1858 Treaty of Limits, and the arbitral awards and judicial decisions that have interpreted and applied it, as the main applicable law to the present dispute. It devotes the first of two chapters dealing with the alleged violations of international and domestic law by Costa Rica – Chapter 4 of its Memorial – to these instruments, under the rubric "Breaches of the Legal Regime of the San Juan de Nicaragua River". Indeed, Chapter 4 is presented as analysing "the law applicable to the case",[279] the *lex specialis* prevailing over other obligations under general international law, although these are also said to be relevant to the present proceedings.

4.2 Obviously the 1858 Treaty of Limits is fundamental to the relations between the Parties in the matter of the River; but that does not mean that it deals with issues that it does not deal with. In truth, nothing in the 1858 Treaty of Limits, nor in its interpretation and application by different adjudicative bodies, prevents Costa Rica from carrying out works on its road infrastructure on its own territory. Contrary to what Nicaragua asserts, undertaking road infrastructure works on Costa Rican territory in no way violates Nicaraguan territorial sovereignty, nor prevents or impairs the right to navigation by Nicaragua to the San Juan. Costa Rica's position is that the 1858 Treaty of Limits has no bearing on the present proceedings. Nicaragua's real purpose of invoking the 1858 Treaty in this case appears to

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279 NM, para. 1.13.

be to invent a purported justification for it to continue to impede Costa Rica from exercising its free and perpetual right of navigation established by the Treaty.[280]

4.3 The present chapter will focus on Nicaraguan efforts to construct obligations purportedly stemming from the 1858 Treaty of Limits that are said to have been "violated" by Costa Rica in undertaking the road works. It will be shown that the instrument which Nicaragua considers the *lex specialis* in this case has no bearing on the present proceedings.

4.4 The cardinal point is that the 1858 Treaty does not regulate road infrastructure works on Costa Rican territory. Rather, it sets out limitations to Nicaragua's sovereignty over the waters of the San Juan River, particularly the Costa Rican perpetual right of free navigation for purposes of commerce and any planned canalisation.[281] It also establishes co-imperium over the two bays in the border area in both oceans, and provides for the common defence of the San Juan River. Beyond this, it is silent with regard to the activities that Costa Rica may perform on its own territory.

B. Nothing in the 1858 Treaty of Limits prevents Costa Rica from undertaking Road Infrastructure Works

4.5 It is true that the 1858 Treaty of Limits is not only a boundary agreement: it also regulates different aspects of the conduct of the Parties in

280 See NM, paras. 6.35-6.42.

281 Further limitations were established by the 1888 Cleveland Award, including in respect of works of improvement on the River: see NM, Vol. II, Annex 6, Award of the Arbitrator, the President of the United States, upon the validity of the Treaty of Limits of 1858 between Nicaragua and Costa Rica, reprinted in United Nations, *Reports of International Arbitral Awards*, Vol. XXVIII (2006) pp. 207-211. The Award was given in English.

relation to the border area. In its 13 July 2009 Judgment in the *Navigational Rights* case, the Court summarised its content as follows:

> "The 1858 Treaty of Limits fixed the course of the boundary between Costa Rica and Nicaragua from the Pacific Ocean to the Caribbean Sea. According to the boundary thus drawn the district of Nicoya lay within the territory of Costa Rica. Between a point three English nautical miles from Castillo Viejo and the Caribbean Sea, the Treaty fixed the boundary along the right bank of the San Juan river. It established Nicaragua's dominion and sovereign jurisdiction over the waters of the San Juan river, but at the same time affirmed Costa Rica's navigational rights "con objetos de comercio" on the lower course of the river (Article VI). The 1858 Treaty established other rights and obligations for both parties, including, *inter alia*, an obligation to contribute to the defence of the common bays of San Juan del Norte and Salinas as well as to the defence of the San Juan river in case of external aggression (Article IV), an obligation on behalf of Nicaragua to consult with Costa Rica before entering into any canalization or transit agreements regarding the San Juan river (Article VIII) and an obligation not to commit acts of hostility against each other (Article IX)."[282]

4.6 Nicaragua's Memorial identifies three alleged "breaches of the 1858 Treaty and its successive arbitral and judicial interpretations".[283] According to Nicaragua, by constructing a road, Costa Rica has breached Nicaragua's sovereignty over the San Juan River,[284] Nicaragua's right of navigation, and Costa Rica's alleged "obligation to notify" also purportedly stemming from the 1858 Treaty.[285] But nothing in the 1858 Treaty or in related awards and

282 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), I.C.J. Reports 2009*, p. 229, para. 19.

283 NM, Chapter 4, Section A.

284 NM, para. 4.3.

285 NM, respectively points 2(a) and 2(b) of Chapter 4.

judgments prevents Costa Rica from constructing a road on its own territory, or provides any other basis for Nicaragua's claims here. Nicaragua has not identified a single sentence either in the 1858 Treaty or in the relevant arbitral awards or judgments that suggests the contrary.

(i) The alleged violation of Nicaraguan territorial sovereignty

4.7 Nicaragua refers in general terms to an alleged "violation of Nicaraguan territorial sovereignty" or "to the fundamental principle of territorial integrity of Nicaragua".[286] Nicaragua's submissions refer to the "obligation not to violate the integrity of Nicaragua's territory as delimited by the 1858 Treaty of Limits, the Cleveland Award of 1888 and the five Awards of the Umpire EP Alexander of 30 September 1897, 20 December 1897, 22 March 1898, 26 July 1899 and 10 March 1900".[287] But Nicaragua goes even further, referring to an alleged "invasion of Nicaraguan territory".[288] These "invasions" and "assaults" were also referred to during the hearings on the request for provisional measures made by Nicaragua.[289]

4.8 The Memorial offers only a brief explanation why the road works on Costa Rican territory constitute a violation of the territorial sovereignty or integrity of Nicaragua, even an invasion of its territory. After quoting Max Huber's celebrated notion of territorial sovereignty in the *Island of Palmas* arbitration, Nicaragua contends:

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286 See NM, para. 4.28 and subtitle 1, p. 232, para. 6.14

287 NM, p. 251, Submission 1 (i).

288 NM, para. 4.13.

289 CR 2013/28, p. 24, para. 1 (McCaffrey); p. 28, par. 15 (McCaffrey); CR 2013/30, p. 16, para. 2 (McCaffrey).

> "failing the existence of a permissive rule to the contrary, a State 'may not exercise its power in any form in the territory of another State.' Yet… this is what Costa Rica has done by dumping soils and sediments, trees and vegetation into the San Juan de Nicaragua Rica [*sic*]. Furthermore, the interception of the natural flow of the waters that flow to the San Juan River modifies the drainage of the surrounding wetlands in the lower San Juan. Consequently, it significantly affects the level and the quality of the water of the San Juan River."[290]

4.9 As a matter of fact, no sediment is "delivered" to the river by Costa Rica. The erosion of sediment into the river from both banks is a natural process that by no means can be assimilated to an "invasion" or violation of sovereignty or territorial integrity. Costa Rica has not exercised any State activity in the territory of Nicaragua by undertaking works on its road infrastructure entirely on its own territory. Nor has it proceeded to dump material into the San Juan River. But even assuming that the road works could have caused harm to the territory of Nicaragua (*quod non*), this would by no means be tantamount to a "violation of the territorial integrity or sovereignty of Nicaragua". Costa Rica has not encroached upon Nicaraguan territory, in clear contrast with Nicaragua's conduct in the northern part of Isla Portillos.[291]

(ii) The alleged violation of Nicaragua's right to navigation

4.10 Although the catalogue of alleged "breaches of the 1858 Treaty of Limits" set out in Nicaragua's Memorial begins by first listing "(a) Breach of Nicaragua's right of navigation",[292] this purported breach is not identified

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290 NM, paras. 4.31 and 4.32 (footnotes omitted).

291 See *Certain Activities*, CRM, paras. 4.70-4.87.

292 NM, p. 128.

in Nicaragua's final submissions. Indeed, in the relevant sub-section, the alleged "breach of Nicaragua's right of navigation" is merely described in the following manner: "The works for the construction of road 1856 constitute a serious *threat on the navigation* on the river – and not only in the short term".[293]

4.11 A great leap of imagination is required to follow Nicaragua's assertion that the road works constitute a violation of the navigational rights of Nicaragua over the San Juan River emanating from the 1858 Treaty of Limits. Indeed, what Nicaragua first categorized as a "breach" became soon just a "threat". On Nicaragua's own case, there has been no impediment by Costa Rica to the navigation of the San Juan. In fact, there is not even the slightest "threat", by action or by implication, to navigation. As explained in Chapter 3 of this Counter-Memorial, the construction works and use of the road in no way impact upon the navigational conditions of the River.

4.12 During the hearings on Nicaragua's request for provisional measures, it submitted evidence that "[t]he San Juan River MARENA Delegation implements monthly waterway patrolling on the San Juan River with the participation of MARENA forest rangers and technical specialists accompanied by the Army of Nicaragua".[294] At no time has Nicaragua contended that this regular patrolling has been rendered more difficult, or indeed affected in any way, by the alleged "catastrophic" effects of the

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[293] NM, para. 4.15 (emphasis added).

[294] **Vol 3, Annex No 18**, Nicaragua, Ministry of Environment and Natural Resources (MARENA), San Juan River Territorial Delegation, *Technical Waterway Patrol on the San Juan River on October, 27 2013*, annexed to the Letter to the Registrar of the Court from His Excellency Carlos Argüello Gomez, Agent of the Republic of Nicaragua, Reference HOL-EMB-220, 31 October 2013, p. 1.

construction work on the 1856 Road. Nor has any other evidence of impairment of navigation been advanced.

(iii) Costa Rica is not obliged under the Treaty of Limits to "notify" Nicaragua

4.13 Nicaragua's Memorial posits an "obligation to notify" that it alleges is binding on Costa Rica by virtue of the 1858 Treaty of Limits. Nicaragua attempts to locate such an obligation in the Court's analysis of Nicaragua's obligation to notify its regulations concerning navigation of the San Juan River to Costa Rica. According to Nicaragua's Memorial:

> "if Nicaragua, the sovereign over the waters of the San Juan River, is bound to notify Costa Rica of the regulations it adopts to regulate the traffic on the river, this is true a *fortiori* for the activities by Costa Rica which have an impact on the navigation over the river – to which Nicaragua is at least as much entitled as the other riparian State (which has no right of sovereignty over the river)."[295]

4.14 This line of reasoning is flawed for a number of reasons. First of all, the activity of Costa Rica which is the subject of the present case has no relation to navigation of the San Juan River, and this fact renders any analysis of such an alleged obligation moot.

4.15 Second, the obligation binding on Nicaragua to notify Costa Rica of its regulations relating to navigation along the San Juan River corresponds directly to the perpetual right of free navigation of Costa Rica on the San Juan River. Despite having quoted some of the relevant paragraphs from the Court's 2009 Judgment devoted to notification of Nicaraguan regulations to

[295] NM, para. 4.23.

navigation, Nicaragua failed to refer to the first part of the Court's analysis, which reads:

> "The Treaty imposes no express general obligation on either of the Parties to notify the other about measures it is taking relating to navigation on the river. It contains a requirement of agreement in Article VI and a requirement of consultation in Article VIII which imply prior contact between the Parties. Under Article VI the two Parties are required to agree if they wish to impose any taxes in the situation contemplated by that provision. Under Article VIII, if the Government of Nicaragua is proposing to enter into an arrangement for canalization or transit on the San Juan, it must first consult with the Government of Costa Rica about the disadvantages the project might occasion between the two Parties."[296]

Hence, the Treaty contains precise provisions related to different levels of mutual conduct with regard to different topics, ranging from contact and consultation to agreement. None of these refers to activities such as the road infrastructure projects on Costa Rican territory.

4.16 Third, in spite of the absence of any specific provision in the Treaty, the Court found that an obligation to notify exists on the basis of three factors:

- the 1956 Agreement to facilitate and expedite traffic on the Pan American Highway and on the San Juan River;
- the very subject-matter of regulation: "navigation on a river in which two States have rights" and "the practical necessities of navigation

[296] *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, p. 251, para. 93.

on such a waterway"; discipline in navigation "depends on proper notification of the relevant regulations"; and

- the very nature of regulation: "[i]f regulation is to subject the activity in question to rules, those undertaking that activity must be informed of those rules".[297]

4.17 None of these factors are applicable to the alleged obligation to notify now invoked by Nicaragua. Works on road infrastructure undertaken entirely on Costa Rican territory have nothing to do with any kind of regulation of navigation along the River. The 1956 Agreement, for its part, refers to traffic in two specific ways: a highway (the Pan American Highway) and a river (the San Juan). It does not apply to the Road, nor can it be construed as implicitly requiring prior notification of new road works.

C. The Treaty of Limits and the motivation behind the Nicaraguan claim

4.18 The thinking underlying Nicaragua's claim is clear from its Memorial:

> "in its Judgment of 2009, the Court noted that 'a simple reading of Article VI' of the Treaty 'shows that': 'the right of free navigation, albeit 'perpetual', is granted [to Costa Rica] only on condition that it does not prejudice the key prerogatives of territorial sovereignty.' Therefore, as far as Costa Rica has breached its obligations regarding the San Juan River and prejudiced Nicaragua's sovereign prerogatives on the River, it has lost its right of free navigation."[298]

297 *Dispute regarding Navigational and Related Rights (Costa Rica v. Nicaragua), Judgment, I.C.J. Reports 2009*, pp. 251-252, paras. 94-96.

298 NM, para. 4.9. See also, paras. 6.35-6.36.

4.19 In its submissions Nicaragua "only" requests the Court to allow it to "suspend" Costa Rica's perpetual right of free navigation.[299] But whether it takes the form of loss or suspension of rights, the substance is much the same: Nicaragua's claim entails a substantial rejection of one of the essential bases of the fundamental instrument between the two countries. The condition for Costa Rica's acceptance of Nicaraguan sovereignty over the entire waters of the San Juan River was precisely recognition of Costa Rica's perpetual right of free navigation for commercial purposes. Such a claim is unfounded both in law and in fact.

D. Conclusions

4.20 To summarize:

(a) the road infrastructure works carried out on undisputed Costa Rican territory in no way infringe the boundary delimited by the 1858 Treaty of Limits, let alone Nicaraguan sovereignty or territorial integrity;

(b) the road infrastructure works undertaken by Costa Rica on Costa Rican territory in no way impede or otherwise impact upon the exercise of any navigational rights of Nicaragua stemming from the 1858 Treaty or otherwise;

(c) there is no obligation on Costa Rica to notify road infrastructure works undertaken on its territory by virtue of the 1858 Treaty of Limits; and

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[299] NM, p. 252, Submission 3(i).

(d) the real purpose of Nicaragua, which is to seek to suspend or terminate Costa Rica's free and perpetual right of navigation on the San Juan River as established in the 1858 Treaty of Limits, must be firmly rejected.

Chapter 5

Alleged Breaches of Obligations in respect of the Environment

A. Introduction

5.1 Chapter 5 of Nicaragua's Memorial is devoted to alleged Costa Rican breaches of its environmental obligations, namely the obligations "to assess the environmental impact of the road, on both the national and transboundary level", "to provide prior notification to Nicaragua" and "not to cause significant transboundary harm". In this context, Costa Rica is said to have breached a broad range of treaties and international instruments through the construction of the Road.

5.2 This Chapter will show that none of the alleged breaches are grounded in law or in fact. Before turning to the details, Costa Rica makes four observations of an introductory kind.

5.3 First, Nicaragua has not contested the fact that the work carried out by Costa Rica to improve its road infrastructure in the border area has been conducted exclusively within Costa Rica's territory. In this respect, the decision to undertake road infrastructure work on its own territory is a sovereign decision of any State. Thus, the starting point in terms of considering the alleged breaches is that Costa Rica, as any other State, is free to make its own appraisal of its own security and communicational needs, and the best means to implement those needs within its territory. The reasons for improving infrastructure, as a sovereign decision, need not be explained or justified at the international level, and still less to a neighbouring State that has recently occupied and claimed part of Costa

Rica's territory, as established by a treaty (the Treaty of Limits) that has been in force for more than one and a half centuries.

5.4 Secondly, and following on from the above, Nicaragua's case is not assisted by allegations that the construction works on the Road were poorly planned or implemented or had adverse impacts to the environment on Costa Rican territory.[300] Even if correct, those are matters internal to Costa Rica.

5.5 Thirdly, underlying the rules relating to transboundary environmental harm there is a general principle relating to cooperation between neighbouring countries. Given that the current claim is to be heard alongside the *Certain Activities* case, Costa Rica makes the point that Nicaragua is currently relying on a series of obligations that it has ignored in the context of *Certain Activities*. Far from cooperating there, Nicaragua undertook activities in the border area (in a river over which Costa Rica possesses rights) not only likely to produce significant adverse transboundary effects on Costa Rican territory, particularly on the Colorado River, but with the very intention of doing so. Far from cooperating with its neighbour, Nicaragua entered onto Costa Rican territory and carried out works in order to transform the river basin, by unlawfully constructing an artificial *caño* across Costa Rican territory in 2010, and (as the Court has now confirmed) two more artificial *caños* in 2013.

5.6 Finally, and notwithstanding Nicaragua's discrepant conduct, when it comes to the key legal principles that apply in respect of actual or potential transboundary environmental impact, there appears to be little if

[300] Cf. NM, paras. 5.11-5.13.

anything that divides the Parties. In Chapter 5 of its Memorial, Nicaragua identifies the existence of three central obligations: an obligation to conduct an environmental impact assessment where there is a risk that works may have a significant impact in a transboundary context; an equivalent obligation of notification; and an obligation not to cause significant transboundary harm.[301] As is already evident from Costa Rica's Memorial in the *Certain Activities* case, Costa Rica accepts the existence of these principles as a general matter so far as concerns its relations with Nicaragua (and other neighbouring States). Costa Rica welcomes Nicaragua's recognition and adoption of these principles, and now turns to their application in the instant case, which is where the positions of the two Parties diverge.

B. Environmental impact assessment

5.7 As noted by Nicaragua,[302] in the *Certain Activities* case, Costa Rica has set out its position that environmental impact assessment is now a well-recognised requirement of general international law.[303] That position was stated by reference to Article 14 of the Convention on Biological Diversity and the well-known passage from the *Pulp Mills* case.[304]

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301 See e.g. NM, para. 5.4.

302 NM, paras. 5.33, 5.35-5.36.

303 *Certain Activities* case, CRM, paras. 5.22-5.23.

304 *Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, I.C.J. Reports 2010*, p. 83, para. 204.

(1) Threshold requirements in respect of the obligation to conduct an environmental impact assessment

5.8 It is recalled that, pursuant to Article 14(1) of the Convention on Biological Diversity:

> "Each Contracting Party, as far as possible and as appropriate, shall:
>
> (a) Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures; …"

5.9 The obligation under Article 14(1) is thus qualified in various ways, and notably applies only in respect of "proposed projects that are likely to have significant adverse effect". There is thus a threshold of likelihood of significant adverse effect that applies.

5.10 To similar effect, the Court in the *Pulp Mills* case stated that:

> " … it may now be considered a requirement under general international law to undertake an environmental impact assessment *where there is a risk that the proposed industrial activity may have a significant adverse impact in a transboundary context*, in particular, on a shared resource. Moreover, due diligence, and the duty of vigilance and prevention which it implies, would not be considered to have been exercised, if a party planning works *liable to affect the régime of the river or the quality of its waters* did not undertake an environmental impact assessment on the potential effects of such works."[305] (Emphasis added.)

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305 *Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, I.C.J. Reports 2010*, p. 83, para. 204.

5.11 As follows from the Court's dicta in *Pulp Mills*, the threshold that applies under general international law so far as concerns undertaking an environmental impact assessment is one of risk of significant adverse impact (in a transboundary context).

5.12 So far as concerns construction of the Road, neither of the above thresholds was met such as to require Costa Rica to carry out an environmental impact assessment. As already noted, the Road was and is being constructed exclusively within Costa Rican territory. Construction of the Road did not and does not lead to the discharge of harmful substances or emissions into the San Juan River or otherwise into Nicaraguan territory. The highest Nicaragua can put its case is by reference to erosion or other loss of relatively insignificant quantities of sediment into the River which, as demonstrated in Chapter 3 above, in no sense risk having a significant adverse impact on the San Juan River, or are liable to affect the régime of the River or the quality of its waters. Thus, insofar as construction of a narrow road is correctly seen as a "proposed industrial activity" within the above passage from the *Pulp Mills* case, the relevant threshold of risk of significant adverse impact is not met. It likewise follows that the threshold of likelihood of significant adverse effect as established by Article 14(1) of the Convention on Biological Diversity is not met.[306]

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306 The same applies with respect to Article 2(3) of the Espoo Convention on which Nicaragua relies (although this is not in force as between the Parties): NM, paras. 5.37-5.39.

(2) Environmental impact assessment in the particular context of an emergency

5.13 The *Pulp Mills* case does not address directly the issue of conduct of an environmental impact assessment in the context of an emergency. However, as follows from the general principles as reflected in *Pulp Mills*, this issue must be approached by reference to the domestic law of the State concerned. In this respect, the Court stated:

> "… it is the view of the Court that it is for each State to determine in its domestic legislation or in the authorization process for the project, the specific content of the environmental impact assessment required in each case, having regard to the nature and magnitude of the proposed development and its likely adverse impact on the environment as well as to the need to exercise due diligence in conducting such an assessment. The Court also considers that an environmental impact assessment must be conducted prior to the implementation of a project. Moreover, once operations have started and, where necessary, throughout the life of the project, continuous monitoring of its effects on the environment shall be undertaken." [307]

5.14 It is thus left to domestic law to define the specific content of the assessment that is required in each individual case. Consistent with this and with the qualifications in the wording of Article 14(1) of the Convention on Biological Diversity ("as far as possible and as appropriate"), where in an exceptional case domestic law establishes that there is no requirement to carry out an assessment because of an emergency, general international law must likewise recognise this aspect of domestic law. It is not a requirement of international law that a *pro forma* environmental impact assessment be

[307] *Pulp Mills on the River Uruguay (Argentina v. Uruguay), Judgment, I.C.J. Reports 2010*, pp. 83-84, para. 205.

carried out regardless of the nature of the individual case and regardless of the specificities of domestic law.[308]

5.15 It follows that Nicaragua is wrong to criticize Costa Rica for having regard to its domestic law, and likewise Nicaragua's reference to Article 27 of the Vienna Convention on the Law of Treaties is misplaced because Costa Rica is not "saying that a self-judging declaration of national emergency … trumps any inconsistent rules of international laws".[309] Rather, the threshold for application of the general international law rule with respect to conduct of an environmental impact assessment is not met and, even if it were otherwise, it would be appropriate as a matter of current international law (as articulated by the Court) to have recourse to domestic law. It follows that Nicaragua's reference to customary international law rules concerning states of necessity is likewise inapposite.[310] Costa Rica has not invoked Article 25 of the ILC's Articles on State Responsibility as Nicaragua correctly points out, and it is not incumbent upon it to do so. As with other States,[311] Costa Rica's domestic legislation does not require the conduct of an environmental impact assessment in an emergency situation, while international law comprises a *renvoi* to domestic law.

5.16 Further, it does not follow from the application of domestic law in this case that there has been no assessment into environmental impact. As

308 See also, by way of analogy, Article 19 of the 1997 United Nations Convention on the Non-Navigational Uses of International Waterways, considered in the context of obligations of notification under Section C below, which modifies the terms of the Convention in cases of "utmost urgency".

309 Cf. NM, paras. 5.23-5.24.

310 Cf. NM, para. 5.27.

311 See, for example, Australia, Environment Protection and Biodiversity Conservation Act 1999 (Cth), in force from 16 July 2000, s. 158(5).

explained in Chapter 3 above, Costa Rica has carried out the Environmental Diagnostic Assessment (**Annex 10** hereto), a lengthy and detailed report that has identified impacts and risks associated with construction of the Road, and that has also recommended environmental control measures necessary to prevent or to mitigate such impacts and risks. If, which is not accepted, there is any form of international law obligation to conduct an environmental impact assessment on the very particular facts of this case, that obligation has been satisfied by completion of the Environmental Diagnostic Assessment.

5.17 Finally, it is to be recalled that this case is all the more exceptional in light of the fact that it is the State complaining of the lack of an environmental impact assessment that, through its own unlawful acts, created the emergency leading to the very activities that are said to be unlawful due to the lack of assessment.

5.18 On Nicaragua's view of the law, a State precipitating an emergency (or what is reasonably perceived as such) is to be accorded important elements of control over the response to that emergency – through the affected State having to delay its response in order to conduct an environmental impact assessment as well as engaging in alleged obligations of notification and consultation. On the particular facts of this case, this would amount to Nicaragua seeking to rely on an alleged breach that stems from its own wrong (cf. *ex turpi causa non oritur actio*).[312]

[312] Cf. *Gabčíkovo/Nagymaros Project (Hungary/Slovakia), Judgment, I.C.J. Reports 1997*, p. 67, para. 110.

5.19 However, the position under international law cannot depend on the State precipitating the given emergency having acted unlawfully. Rather, as a general principle, the acts of the responding State cannot be delayed by and subjected to the alleged procedural rights of the State precipitating the emergency, regardless of whether the precipitating State has acted lawfully or unlawfully.[313] To similar effect, it could not be open to a State to precipitate the given emergency and then to assert rights to information in relation to the planned response to that emergency.[314]

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313 Cf. *Gabčíkovo/Nagymaros Project (Hungary/Slovakia), Judgment, I.C.J. Reports 1997*, p. 66, para. 107.

314 Cf. NM, paras. 5.51-5.56. The contention that Costa Rica failed to provide information to Nicaragua would anyway fail for the separate reason that it was Costa Rica who wrote to Nicaragua on 29 November 2011, before Nicaragua initiated proceedings in the present case, and invited Nicaragua to enter into a cooperative dialogue with Costa Rica: *Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica)*, Application Instituting Proceedings, 21 December 2011, Annex 17, Note from the Minister of Foreign Affairs of Nicaragua to the Minister of Foreign affairs of Costa Rica, Reference MRE/DVM/AJST/500/11/11, 29 November 2011. Nicaragua was publicly making allegations about Costa Rica's road infrastructure works, but it had not provided any basis for these allegations, nor had it raised these directly with Costa Rica Nicaragua's response was litigious, not cooperative. It initiated the present proceedings on 22 December 2011. It is also noted that, when Costa Rica proposed to undertake regular joint monitoring of the waters of the San Juan River in order to determine the real impact, if any, of the road works, Nicaragua rejected this proposal. See **Vol 3, Annex No 46**, Note from Minister of Foreign Affairs and Worship, Costa Rica, to Foreign Affairs Minister, Nicaragua, Reference DM-AM-063-13, 6 February 2013; **Vol 3, Annex No 48**, Note from Foreign Affairs Minister, Nicaragua, to Minister of Foreign Affairs and Worship, Costa Rica, Reference MRE/DM-AJ/129/03/13, 5 March 2013; **Vol 3, Annex No 49**, Letter from Co-Agent of Costa Rica to Registrar of the International Court of Justice, Reference ECRPB-013-2013, 7 March 2013; **Vol 3, Annex No 52**, Letter from Co-Agent of Costa Rica to Registrar of the International Court of Justice, Reference ECRPB-26-13, 24 May 2013; **Vol 3, Annex No 53**, Letter from Co-Agent of Costa Rica to Registrar of the International Court of Justice, Reference ECRPB-31-13, 13 June 2013; **Vol 3, Annex No 54**, Letter from Agent of Nicaragua to Registrar of the International Court of Justice, Ref. HOL-EMB-108, 14 June 2013; **Vol 3, Annex No 55**, Letter from Co-Agent of Costa Rica to Registrar of the International Court of Justice, Reference ECRPB-036-13, 24 June 2013; **Vol 3, Annex No 59**, Letter from Co-Agent of Costa Rica to Registrar of the

C. Notification

5.20 Nicaragua's case on breach of an alleged obligation of notification fails for the same basic reasons, i.e. the relevant threshold is not met.[315] In any event the alleged obligation does not apply in a context where the State claiming a right to be notified has itself precipitated an emergency that is being responded to.

5.21 In addition, in this context, Nicaragua relies on materials that are irrelevant, i.e. the ILC's draft Articles on Prevention of Transboundary Harm from Hazardous Activities,[316] or inapplicable even on Nicaragua's submissions, i.e. the 1997 United Nations Convention on the Non-Navigational Uses of International Waterways.[317] The latter is relied upon merely on the basis that its articles "provide an indication of how the notification should properly unfold",[318] and not on the basis that these reflect customary international law. It is not explained how rules that are intended to apply under general circumstances are to be applied in very particular circumstances where it was Nicaragua itself, the other riparian of

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International Court of Justice, Reference ECRPB-052-13, 7 August 2013; **Vol 3, Annex No 60**, Letter from Registrar of the International Court of Justice to Agent of Costa Rica, Reference 142331, 8 August 2013; **Vol 3, Annex No 64**, Letter from Agent of Nicaragua to Registrar of the International Court of Justice, Reference HOL-EMB-167, 30 August 2013; **Vol 3, Annex No 65**, Letter from Co-Agent of Costa Rica to Registrar of the International Court of Justice, Reference ECRPB-63-2013, 27 September 2013; and **Vol 3, Annex No 66,** Letter from Registrar of the International Court of Justice to Agent of Costa Rica, Reference 142549, 27 September 2013.

315 Cf. NM, para. 5.45 (relying on Principle 19 of the 1992 Rio Declaration), and para. 5.46 (relying on Article 3 of the Espoo Convention).

316 NM, para. 5.47.

317 NM, para. 5.48.

318 *Ibid*.

the San Juan River, which was the State responsible for bringing about the state of emergency to which Costa Rica has been responding. Consequently, it could never be anticipated that Costa Rica would follow a procedure similar to that established by the 1997 Convention (assuming *arguendo* that such was required), not least as that could risk frustrating the very measure taken in response to Nicaragua's actions.

5.22 Nicaragua draws specific attention to Articles 12 and 19 of the 1997 Convention,[319] but neither provision is of assistance to it (even leaving to one side the obvious point that neither Nicaragua nor Costa Rica are parties to the 1997 Convention). Article 12 establishes an obligation of notification in respect of "planned measures which may have a significant adverse effect upon other watercourse States". As follows from Chapter 3 above, construction of the Road is not such a measure. But, even if it were otherwise, Article 19(1) would come into play on the facts of this case. This provides:

> "In the event that the implementation of planned measures is of the utmost urgency in order to protect public health, public safety or other equally important interests, the State planning the measures may, subject to articles 5 and 7, immediately proceed to implementation, notwithstanding the provisions of article 14 and paragraph 3 of article 17."

5.23 In light of the factors identified in Chapter 2, this provision would have been brought into play in Costa Rica's construction of the Road. Nicaragua relies on the fact that Costa Rica would nonetheless be bound by Articles 5 and 7 relating to equitable and reasonable utilisation and no

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319 NM, paras. 5.48-5.49.

significant harm.[320] The difficulty with this is that, as follows from Chapter 3 above, Nicaragua comes nowhere near establishing breach of either of those provisions.

5.24 It is also to be noted that the alleged failure is purely formalistic in nature. At the same time as alleging a failure to notify, Nicaragua states that it was well aware of construction of the Road (on this point at least, it can readily be believed, given the highly militarised character of Nicaragua's presence along the River).[321] To similar effect, it complains of the failure to provide "any environmental impact assessment" while at the same time saying that none existed.[322] It is as if the provisions of the 1997 Convention had been developed to enable a point-scoring exercise.

D. Alleged significant transboundary harm

5.25 The allegation of significant transboundary harm is not made out on the evidence, and it is notable that, as follows from Chapter 3 above, the allegation was made without the detailed consideration of impact on the Río San Juan's existing sediment load that constitutes the obvious prerequisite to any serious case on harm. It is also notable that the high water mark of Nicaragua's case here is the CACJ "Judgment" of 21 June 2012,[323] despite this being a case made by a court without jurisdiction, without reference to scientific evidence, and without of course Costa Rica before it.

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320 NM, para. 5.48.

321 NM, para. 5.50.

322 NM, para. 5.49.

323 NM, para. 5.62.

5.26 Far from proving that construction of the Road has caused significant harm, Nicaragua has failed to prove that there has been any harm or that there is any potential for significant harm to the San Juan River. On the contrary, on the basis of solid scientific evidence, Costa Rica has established that there has been no harm.

E. Other treaties relied on by Nicaragua

(1) Alleged breaches of the Convention on Biological Diversity

5.27 Nicaragua has invoked the Convention on Biological Diversity, claiming specifically an alleged violation by Costa Rica of the obligations established in its Articles 3, 8 and 14.[324]

5.28 Article 3 of the Convention on Biological Diversity contains the general principle that activities should not cause damage to the environment of other States.[325] As explained in Chapter 3 above, Costa Rica has not caused any such damage. As also follows from Chapter 3, there is no basis for Nicaragua's allegation of breach of Article 8, which is concerned with the promotion of protection of ecosystems, sustainable development and the rehabilitation of degraded ecosystems.[326]

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324 NM, paras. 5.66-5.72.

325 Article 3 provides: "States have, in accordance with the Charter of the United Nations and the principles of international law, the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction."

326 Nicaragua refers to Article 8(d), (e) and (f). Article 8 provides in relevant part:
"Each Contracting Party shall, as far as possible and as appropriate: …
(d) Promote the protection of ecosystems, natural habitats and the maintenance of viable populations of species in natural surroundings;

5.29 As to Article 14(1), Nicaragua relies on sub-articles (a) to (c),[327] which are as follows:

> "1. Each Contracting Party, as far as possible and as appropriate, shall:
>
> (a) Introduce appropriate procedures requiring environmental impact assessment of its proposed projects that are likely to have significant adverse effects on biological diversity with a view to avoiding or minimizing such effects and, where appropriate, allow for public participation in such procedures;
>
> (b) Introduce appropriate arrangements to ensure that the environmental consequences of its programmes and policies that are likely to have significant adverse impacts on biological diversity are duly taken into account;
>
> (c) Promote, on the basis of reciprocity, notification, exchange of information and consultation on activities under their jurisdiction or control which are likely to significantly affect adversely the biological diversity of other States or areas beyond the jurisdiction, by encouraging the conclusion of bilateral, regional or multilateral arrangements, as appropriate;".

5.30 There has been no breach of general international law obligations with respect to conduct of an environmental impact assessment, as established in Section B above. As to specific obligations that might be seen to arise under Article 14 (a) and (b), these provisions concern the introduction of appropriate procedures and arrangements with respect to proposed projects, programmes and policies that are likely to have

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(e) Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas;
(f) Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies; …"

[327] NM, paras. 5.71-5.72.

significant adverse effects on biological diversity. Costa Rica has in place such appropriate procedures and arrangements, and Nicaragua has failed to show the contrary. However, such appropriate procedures and arrangements apply with respect to proposed projects that are likely to have significant adverse effects on biological diversity, whereas the construction of the Road does not fit within that characterisation (see further under Section B above).

5.31 With regard to sub-article (c), even leaving to one side this threshold point, Nicaragua fails to refer to the reciprocity that is required and also takes no account of the object of the notification with which this provision in concerned, which is "encouraging the conclusion of bilateral, regional or multilateral arrangements, as appropriate". As Nicaragua's conduct in the *Certain Activities* case reveals, the condition of reciprocity is absent. Indeed, Nicaragua has consistently failed to inform Costa Rica about its planned work of dredging and deviation of waters of the San Juan River and other border infrastructure projects. Further, sub-article (c) is of no application to the construction of the Road, as Nicaragua's claim does not concern any alleged failure to encourage the conclusion of bilateral, regional or multilateral arrangements.

(2) Alleged breaches of the Ramsar Convention

5.32 Nicaragua relies on Articles 3(1) and 5 of the Ramsar Convention, which concern the formulation and implementation of plans to promote the conservation of wetlands, and a related obligation of consultation.[328] The construction of the Road in no way touches upon protected Nicaraguan

[328] NM, paras. 5.74-5.76. It is noted that the very same obligations on which Nicaragua relies in the present case were breached by Nicaragua as established by Costa Rica in the *Certain Activities* case.

wetlands falling within the Ramsar Convention, while it leads to no risk of significant harm to the Río San Juan, let alone protected wetlands in Nicaragua. For this reason, Nicaragua's reliance on this Convention in the present case is misconceived.

5.33 For completeness, it is noted that a 22 km section of the Road is constructed on a site declared by Costa Rica as a protected wetland. Costa Rica has consequently notified the Secretariat of the Ramsar Convention.[329]

(3) Alleged breaches of the Central American Convention for the Protection of the Environment and other regional instruments

5.34 Nicaragua contends that construction of the Road is incompatible with the "regional system of cooperation for the optimal and rational use of the region's natural resources" that is established by Article I of the Central American Convention for the Protection of Environment, and "flies in the face" of the objectives of that system of cooperation, which are as spelled out in Article II of that Convention.[330]

5.35 This Convention is of no relevance to the present dispute, as is reflected by Nicaragua's failure to set out and detail alleged breaches of any specific provision. Rather, Nicaragua makes the unsubstantiated assertions summarised above. The Memorial also refers to the establishment of the

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[329] **Vol 3, Annex No 43**, Note from Minister of Foreign Relations and Worship, Costa Rica, to Secretary General of the Ramsar Convention, Reference DM-110-12, 28 February 2012; **Vol 3, Annex No 44**, Note from Secretary General of the Ramsar Convention to the Minister of Foreign Relations and Worship, Costa Rica, 6 June 2012.

[330] NM, paras. 5.81-5.84. See e.g. Article II(a) of the Convention, establishing the objective: "To instil respect for and protect the region's natural heritage, which is characterized by its high level of biological and ecological diversity."

Central American Commission on Environment and Development by this Convention.[331] The Commission is a political organ with no technical expertise and no mandate to undertake technical studies. In any event, this Commission has not submitted any technical or scientific report of any kind in relation to the Road.

5.36 A similar scatter-gun approach is taken by Nicaragua in its unparticularised and untenable assertion that Costa Rica's conduct is in conflict with the "objectives" of the Tegucigalpa Protocol to the Charter of the Central American Integration System.[332] Nicaragua likewise alleges that Costa Rica's conduct contravenes several of the "fundamental principles" set out in Article 4 of the Protocol, seemingly on the basis that the works on the Road are said not to constitute "harmonious and balanced regional development". However, nothing in the Protocol lends support to Nicaragua's argument that works undertaken by a Central American State to improve its road infrastructure cut across the Protocol's fundamental principles. In this respect, it is to be noted that, Article 4(e) of the Protocol, which is emphasised by Nicaragua, merely establishes as a fundamental principle:

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331 NM, para. 5.85.

332 NM, paras. 5.86-5.87, referring to objectives (b), (h) and (i) at Article 3 of the Protocol. Objective (b) is: "To define a new regional security model based on a reasonable balance of forces, the strengthening of civilian government, the elimination of extreme poverty, the promotion of sustained development, protection of the environment, and the eradication of violence, corruption, terrorism, and trafficking in drugs and arms." Objective (h) is: "To promote, in a harmonious and balanced manner, the sustained economic, social, cultural and political development of the Member States and of the region as a whole." Objective (i) is: "To carry out concerted action to protect the environment through respect for and harmony with nature, while ensuring balanced development and the rational exploitation of the natural resources of the area, with a view to establishing a new ecological order in the region."

> "The phased, specific and progressive nature of the process of economic integration, based on harmonious and balanced regional development, with special treatment for relatively less developed Member States, and on equity and reciprocity, and the Central American Exception Clause."

That principle is evidently of no relevance to the current claim.[333]

5.37 There is likewise no tenable basis to the assertion that works on the Road are contrary to Article 6 of the Protocol on the basis that they "may endanger the attainment of the objectives and compliance with the fundamental principles of the Central American Integration System".[334] Such assertions are frivolous.

5.38 Nicaragua alleges breach of obligations of no harm, cooperation and conservation said to arise under the 1992 Convention for the Conservation of Biodiversity and the Protection of Wilderness Areas in Central America.[335] To the extent that the provisions relied on by Nicaragua impose obligations on Costa Rica, Nicaragua's case under this Convention fails for equivalent reasons to those identified above in relation to the Convention on Biological Diversity and the Ramsar Convention.

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333 Nicaragua also refers to Article 4(h) of the Protocol, which establishes as a fundamental principle: "Good faith on the part of the Member States in the discharge of their obligations; Member States shall abstain from establishing, agreeing to or adopting any measure that contravenes the provisions of this instrument or that impedes compliance with the fundamental principles of the Central American Integration System or the attainment of its objectives." See NM, para. 5.88. It is unclear what Nicaragua seeks to derive from this.

334 Pursuant to Article 6 of the Protocol: "The Members of the Central American Integration System shall be those Central American States that fully accept the obligations set forth in this Charter by means of their approval or ratification thereof or accession hereto, and that implement this Charter in accordance with the provisions of article 36 hereof."

335 NM, paras. 5.93-5.98.

5.39 Finally, under this category, Nicaragua relies on the Regional Agreement on the Transboundary Movement of Hazardous Wastes, on the basis that Costa Rica is "dumping debris and other waste from its road project into the San Juan".[336] There is no factual basis for such a claim: there is no dumping by Costa Rica; sediment is not hazardous waste; there is no basis for speculating that sediment may contain hazardous waste.

(4) Agreement on Border Protected Areas

5.40 Nicaragua also alleges breach by Costa Rica of the bilateral Agreement on Border Protected Areas ("SI-A-PAZ").[337] In its Counter-Memorial in the *Certain Activities* case, Nicaragua stated that the provisions of this treaty were "[p]ositive and laudable steps to advance conservation and sustainable development of this system of protected areas, to be sure, but not ones that require the parties to do or refrain from doing anything specific in those areas".[338] Costa Rica does not share the same view of this Agreement and expects that Nicaragua will act in accordance with its provisions, as it is obliged to do. For present purposes, however, the point is simply that Nicaragua has identified no provision of the Agreement that Costa Rica's conduct is said to have breached. If, as is understood, the allegation comes down to one of causing significant harm to an area of exceptional biodiversity, the allegation fails for the reasons given in Chapter 3 above.

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[336] NM, paras. 5.99-5.100.

[337] NM, para. 5.104.

[338] *Certain Activities* case, NCM, para. 5.150.

F. Conclusions

5.41 To summarize:

(a) Costa Rica has not breached any obligation to carry out an environmental impact assessment. The threshold requirement of significant adverse impact is not met, and therefore there is no obligation to carry out any such assessment. Moreover, Nicaragua's argument to the contrary ignores the pressing circumstances in which the Road was constructed which, under Costa Rican law (as to which see the *renvoi* under international law), exempted Costa Rica from having to carry out an impact assessment in advance.

(b) Costa Rica has not breached any obligation to notify Nicaragua. Again, the threshold requirement of significant adverse impact is not met and therefore Costa Rica was not obliged to notify Nicaragua. Nicaragua relies on instruments that are either irrelevant or inapplicable, and again it ignores the emergency circumstances in which the Road was constructed.

(c) Nicaragua has failed to demonstrate that the Road has caused any significant transboundary harm, or that there is any potential for any such significant harm.

(d) Costa Rica has not breached any obligations under any other treaty invoked by Nicaragua (including the Convention on Biological Diversity, the Ramsar Convention, the Central American Convention for the Protection of the Environment, and the SI-A-PAZ Agreement).

Chapter 6

Remedies

A. Introduction

6.1 The remedies sought by Nicaragua are set out in Chapter 6 of Nicaragua's Memorial and in its Submissions. First, Nicaragua requests provisional measures, a request which, as explained in **Section B** below, has already been rejected by the Court. Secondly, Nicaragua seeks remedial relief. In particular, Nicaragua claims compensation for alleged actual harm and/or prejudice that it has suffered as a result of the road infrastructure works and it seeks various declarations of wrongful conduct. For the reasons explained in **Section C** below, these claims must be dismissed. Finally, Nicaragua requests that the Court endorse its claim to suspend Costa Rica's perpetual treaty right of navigation on the San Juan River. This request must be dismissed for the reasons set out in **Section D** below.

B. Nicaragua's Requests for Provisional Measures

6.2 First, Nicaragua claims what it terms "urgently needed immediate remediation measures",[339] which is a request for provisional measures *proprio motu*.[340] As Costa Rica explained in its letter to the Court dated 7 February 2013, this request was inappropriate.[341] It is not for Nicaragua to request the Court to exercise its power to indicate provisional measures

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339 NM, Chapter 6, Section A.

340 NM, para. 6.3; see also **Vol 3, Annex No 45**, Letter from Nicaragua to the International Court of Justice, Reference 02-19-12-2012, 19 December 2012, p. 2.

341 **Vol 3, Annex No 47**, Letter from Costa Rica to the International Court of Justice, Reference ECRPB-0005-13, 7 February 2013.

proprio motu. Nicaragua explicitly declined to make a formal request in accordance with the requirements of the Rules.[342]

6.3 Nicaragua's request for provisional measures was summarily rejected by the Court on 11 March 2013.[343] Nicaragua's submission requesting the Court "to order Costa Rica to immediately take … emergency measures"[344] has therefore already been rejected by the Court.

6.4 On 14 June 2013, in response to Costa Rica's request for modification of the provisional measures indicated in the *Certain Activities* case, Nicaragua requested the Court to modify its Order of 8 March 2011 in the *Certain Activities* case, to indicate that the Parties refrain from conduct which might aggravate or extend the dispute before the Court to the two joined cases, i.e. to the *Construction of a Road* case. The Court definitively rejected this request in its Order of 16 July 2013, recalling that it had already rejected Nicaragua's request for provisional measures on 11 March 2013.[345] The Court stated that Nicaragua's request "does not have any bearing on the situation addressed in [the Order of 8 March 2011]" and that the joinder of proceedings

> "… is a procedural step which does not have the effect of rendering applicable *ipso facto*, to the facts underlying the [*Construction of a Road* case], the measures prescribed with

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342 NM, para. 6.6. See Articles 73(1), 73(2) and 74(3) of the Rules of the Court.

343 **Vol 3, Annex No 50**, Letter from the International Court of Justice to Costa Rica, Reference 141641, 11 March 2013.

344 NM, Submissions, para 4, pp 252-253.

345 *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua); Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica), Requests for the Modification of the Order of 8 March 2011 indicating Provisional Measures, Order*, 16 July 2013, paras. 26-29.

> respect to a specific and separate situation in the [*Certain Activities* case]. Moreover, even if the situation invoked in the [*Construction of a Road* case] were to justify the indication of provisional measures, the appropriate method of securing that is not the modification of the Order made in the [*Certain Activities* case]."[346]

6.5 Following the Court's Order of 16 July 2013 rejecting Nicaragua's request for modification of provisional measures, on 1 August 2013 Nicaragua issued a press release concerning the Court's Order, which it distributed to the Permanent and Observer Missions to the United Nations on 5 August 2013. According to Nicaragua's press release:

> "… Nicaragua revalidated that the behaviour of the Republic of Costa Rica, in building a 160-kilometer road along the Rio San Juan in Nicaragua without proper environmental impact studies, and other technical documents, presents an aggravation of the dispute and a breach of International Law. Therefore, Nicaragua presented as a second request to the ICJ, the need for it to order that both Parties in the now accumulated cases refrain from any action which might aggravate or extend the dispute that both countries have before the ICJ. The ICJ considered Nicaragua's request necessary, and through the Ordinance of July 16, 2013, reiterated the need to abstain "from any action which might aggravate or extend the dispute before the Court or make it more difficult to resolve," thus making this Ordinance applicable to all the facts and rights in the accumulated trial."[347]

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346 *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua); Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica), Requests for the Modification of the Order of 8 March 2011 indicating Provisional Measures, Order*, 16 July 2013, para. 28.

347 **Vol 3, Annex No 57**, Letter from Permanent Mission of Nicaragua to the United Nations to the Permanent and Observer Missions of the United Nations, attaching a Press Release dated 1 August 2013, Ref MINIC-MIS-114-13, 5 August 2013, p. 3.

Thus Nicaragua contended, before the United Nations, that the Court's Order of 8 March 2011 in the *Certain Activities* case was rendered applicable to the *Construction of the Road* case, by the Court's Order of 16 July 2013. This is incorrect. The Court rejected Nicaragua's request for modification in no uncertain terms, noting that "joinder is a procedural step which does not have the effect of rendering applicable *ipso facto*, to the facts underlying the *Nicaragua v. Costa Rica* case, the measures prescribed with respect to a specific and separate situation in the *Costa Rica v. Nicaragua* case."[348] By responsive letter dated 7 August 2013, Costa Rica explained Nicaragua's misrepresentations to the United Nations,[349] and informed the Court by separate letter dated 26 August 2013.[350]

6.6 On Friday 11 October 2013 Nicaragua presented a Request for Provisional Measures in this case. It asked the Court to hear its Request concurrently with Costa Rica's Request for New Provisional Measures in the *Certain Activities* Case.[351] The Court declined to do so, and set dates for a hearing of Nicaragua's Request from 5 to 8 November 2013. On 13 December 2013, the Court unanimously rejected Nicaragua's Request for

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348 *Certain Activities Carried out by Nicaragua in the Border Area (Costa Rica v. Nicaragua); Construction of a Road in Costa Rica along the San Juan River (Nicaragua v. Costa Rica), Requests for the Modification of the Order of 8 March 2011 indicating Provisional Measures, Order*, 16 July 2013, para. 28.

349 **Vol 3, Annex No 58**, Letter from Permanent Mission of Costa Rica to the United Nations to the Permanent and Observer Missions of the United Nations, Reference MCRONU-458-13, 7 August 2013, attaching Position of Costa Rica in relation to a Press Release dated 1 August 2013 circulated by the Permanent Mission of Nicaragua to all Permanent and Observer Missions to the United Nations on 5 August 2013, 7 August 2013

350 **Vol 3, Annex No 62**, Letter from Costa Rica to the International Court of Justice, Reference ECRPB-055-13, 26 August 2013.

351 **Vol 3, Annex No 67**, Letter from Nicaragua to the ICJ, Reference HOL-EMB-196, 11 October 2013.

Provisional Measures.[352] In respect of Nicaragua's Request that Costa Rica immediately provide an Environmental Impact Assessment Study and all technical reports and assessments on Road, the Court noted that "this request is exactly the same as one of Nicaragua's claims on the merits" and held that "[a] decision by the Court to order Costa Rica to provide Nicaragua with such an Environmental Impact Assessment Study as well as technical reports at this stage of the proceedings would therefore amount to prejudging the Court's decision on the merits of the case."[353] In respect of Nicaragua's remaining requests (that Costa Rica take a number of emergency measures to reduce or eliminate erosion, landsides and sediment delivery into the San Juan River; and that Costa Rica not renew any construction activities with respect to the Road), the Court held that Nicaragua had not shown any real or imminent risk of irreparable prejudice to its rights.[354] The Court noted that the evidence so far adduced by Nicaragua "has not established in the current proceedings that the ongoing construction works have led to a substantial increase in the sediment load in the river." It noted further that "Nicaragua did not contest the statement of Costa Rica's expert, Professor Thorne, that, even according to the figures provided by Nicaragua's expert, Professor Kondolf, the construction activities are only contributing 1 to 2 per cent of the total sediment load in the San Juan River and 2 to 3 per cent in the lower San Juan River."[355] The Court having issued its Order on Nicaragua's Request of 11 October 2013, it

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352 *Construction of a Road in Costa Rica Along the San Juan River (Nicaragua v. Costa Rica), Request presented by Nicaragua for the Indication of Provisional Measures, Order*, 13 December 2013, para. 39.

353 *Ibid*, para. 21.

354 *Ibid*, para. 35. See also paras. 24-34.

355 *Ibid*, para. 34.

follows that there is no extant request for Provisional Measures that the Court need address in this case.

C. Nicaragua's requests for declaratory relief

6.7 In Chapter 6 of its Memorial, and in its submissions, Nicaragua sets out a catalogue of claims to forms of reparation, including:

(a) a declaration of unlawful conduct and responsibility;

(b) an order requiring Costa Rica to cease its unlawful conduct, and an order that Costa Rica is required to perform its obligations;

(c) assurances and guarantees of non-repetition; and

(d) a declaration that Costa Rica is not entitled to continue or undertake further development in its territory without an appropriate transboundary Environmental Impact Assessment which is provided to Nicaragua.

6.8 Each of these claims is premised on an internationally wrongful act or acts having been committed by Costa Rica. For reasons explained in Chapters 3, 4 and 5 above, Nicaragua has not demonstrated that any such internationally wrongful acts have occurred.

6.9 Furthermore, Costa Rica has submitted with this Counter Memorial the "Environmental Diagnostic Assessment" for the Road. As explained in Chapter 2 above, this Environmental Diagnostic Assessment has been completed in accordance with the guidelines of Costa Rica's administrative regulations for a project which has already been constructed, including under emergency circumstances, which was the case for the Road. The Environmental Diagnostic Assessment covers the entire 108 km of the Road in the vicinity of the San Juan River, from Boundary Marker 2 to Delta Costa Rica. It considers the existing physical environment where the Road is constructed, including the climate, hydrology, terrestrial and aquatic flora and fauna, and ecology. It incorporates recommendations for the work to complete the Road, taking account of any potential risk of environmental impact. Thus, it is fully compliant with the requirements set out by Costa Rican regulations for a project of this type.

6.10 In its Submissions, Nicaragua also requests that the Court issue two declarations relating to dredging of the San Juan River: first, that it is entitled to execute works to improve navigation "as it deems suitable", including dredging "to remove sedimentation and other barriers to navigation"; and secondly, that it is "entitled to re-establish the conditions of navigation that existed at the time the 1858 Treaty was concluded."[356]

6.11 These requests are not elaborated in Nicaragua's Memorial. They are duplicative of the submissions made by Nicaragua in the *Certain Activities* case[357] and ought to be dealt with in the context of that case. Indeed, this is the third time Nicaragua has made this same request: it made the same requests in the *Navigational Rights* case and the Court definitively rejected them, noting that these issues were settled in the Cleveland Award.[358] For

356 NM, Submissions, p. 352, paras. 3(i) and 3(ii), p 252.

357 *Certain Activities*, NCM, Submissions, pp. 455-456, paras. 2(iii) and 2(iv).

358 *Dispute Regarding Navigational and Related Rights (Costa Rica v Nicaragua), Judgment, I.C.J. Reports 2009*, p. 269, para. 155.

the same reasons, Nicaragua's requests for these declarations should be rejected.

D. Nicaragua's Remedial Claims

6.12 Nicaragua also claims monetary compensation.[359] To satisfy a claim for compensation, a State must (1) specify the head of damage and quantify the harm,[360] and (2) establish a sufficient causal connection between the harm and an internationally wrongful act.[361] Nicaragua claims reparation in the form of pecuniary compensation. This claim must be dismissed. Nicaragua has not demonstrated that it has suffered or will suffer any compensable loss, nor that any such loss is the result of an internationally wrongful act by Costa Rica. Nicaragua alleges that it has suffered financially assessable loss for the following:

(a) costs of "cleaning of the San Juan de Nicaragua (the removal of soil, trees and other vegetation as well as the restoration of the quality of the water of the San Juan River)";

(b) "additional costs" for dredging; and

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359 NM, para. 6.33.

360 *Fisheries Jurisdiction (Federal Republic of Germany v. Iceland), I.C.J. Reports 1974*, p. 204, para. 76.

361 *Military and Paramilitary Activities in and against Nicaragua (Nicaragua v. United States of America), Merits, Judgment, I.C.J. Reports 1986*, pp. 142-143, para. 284. See also International Law Commission, Articles on the Responsibility of States for Internationally Wrongful Acts [2001-II(2)] *Yearbook of the International Law Commission* 26, Article 36.

(c) "losses and increased costs in the sector of tourism, fishing and public health."[362]

6.13 These allegations are accompanied by a litany of cross-references to the Memorial and to the 2012 Kondolf Report.[363] Those cross-references are to unsupported allegations of harm caused to the San Juan River by the road infrastructure works. None of the paragraphs or documents cited by Nicaragua established that it has suffered any compensable loss. Nicaragua's claim to compensation is completely unsubstantiated and must be dismissed. In particular:

(a) Nicaragua has not discharged its burden of proof in respect of its claim that the construction of the Road has caused damage to the San Juan River which would require "cleaning", restorative works for the quality of the water and/or dredging works. For the reasons explained in Chapter 3 above, the road infrastructure works have not caused such damage to the San Juan River.

(b) Nicaragua's claim that it has suffered compensable losses relating to tourism, fishing and public health is entirely unsubstantiated. Such losses are not even mentioned in the Kondolf Report. As explained in Chapter 3 above, Nicaragua's annexes contain one reference to the impact of the road works on tourism, in a Nicaraguan press article,

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362 NM, para. 6.33 (references omitted).

363 **NM, Vol. II, Annex No 1**, G. Mathias Kondolf, *Environmental Impacts of Juan Rafael Mora Porras Route 1856, Costa Rica, on the Río San Juan, Nicaragua*, December 2012 (the ***2012 Kondolf Report***).

which asserts that "tourists make faces when they see the road."[364] This is insufficient to support a claim. So far as concerns fishing and public health, as explained in Chapter 3 above, Nicaragua has not provided any evidence of harm which would sustain a claim for breach, and then to compensation for such breach.

6.14 For the reasons explained in Chapters 3, 4 and 5 above, Nicaragua has failed to discharge its burden to demonstrate that the road infrastructure works are in breach of any international obligation binding on Costa Rica, and that they have caused any actual harm to the San Juan River or to Nicaragua. Nor has it demonstrated that it has incurred any compensable loss as the result of that alleged harm. It follows that Nicaragua's request for compensation must be dismissed.

E. Nicaragua's Request to Suspend Costa Rica's Perpetual Right of Free Navigation

6.15 Nicaragua claims that "[t]he prejudice to Nicaragua's territory affects the navigational rights granted by the 1858 Treaty to Costa Rica".[365] This appears to be an ill-disguised and impermissible attempt to re-litigate the Court's 2009 judgment in *Navigational Rights*.[366] It is in reality another in a series of attempts by Nicaragua to eliminate Costa Rica's navigational rights on the San Juan River. In the first instance, Nicaragua refused to recognize the existence and scope of Costa Rica's right, in the *Navigational*

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364 NM, Vol II, Annex No 26, La Prensa, Nicaragua, "Surrounding Damage Could not be Hidden", 14 January 2012, p. 448.

365 NM, p. 244 (heading 5).

366 *Dispute Regarding Navigational and Related Rights (Costa Rica v Nicaragua), Judgment, I.C.J. Reports 2009*, p. 213.

Rights case. Having failed in its arguments before the Court, Nicaragua introduced a wide range of regulations applicable to Costa Rican navigation on the San Juan – in deliberate disregard of the Court's Judgment, which specified that any regulation applied by Nicaragua to navigation on the San Juan River should apply on a non-discriminatory basis.[367] Now Nicaragua has fabricated a dispute alleging – without any concrete evidence – that Costa Rica has caused damage to the San Juan and thereby prejudiced its right of navigation. Nicaragua's new attempt to prevent Costa Rica from exercising its treaty right of free navigation should be rejected outright by the Court.

6.16 More fundamentally, Nicaragua's request seeks to undermine the very foundation of the 1858 Treaty. As Article VI of the 1858 Treaty makes clear, Nicaragua's sovereignty is subject to Costa Rica's perpetual right of free navigation. This is clear from the plain language of Article VI, which provides:

> "The Republic of Nicaragua shall have exclusive *dominium* and *imperium* over the waters of the San Juan river from its origin in the lake to its mouth at the Atlantic Ocean; the Republic of Costa Rica shall however have a perpetual right of free navigation on the said

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367 **Vol 3, Annex No 26,** Nicaragua, Executive Decree No 79-2009 of 24 September 2009, 'Creation of the Inter-institutional Commission to Develop and Implement the Regulations Regarding Navigation on the San Juan River, specifically where the International Court of Justice Grants Limited Navigation Rights to the Republic of Costa Rica', published in the Gazette of 1 October 2009. See also **Vol 3, Annex No 34**, Note from the Minister of Foreign Affairs of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DM-AM-816-09, 20 November 2009.

> waters between the mouth of the river and a point located three English miles below Castillo Viejo …"[368]

6.17 As the Court made clear in its 2009 Judgment, the 1858 Treaty does not establish any hierarchy between Nicaragua's sovereignty and Costa Rica's right of free navigation: each of them co-exist:

> "A simple reading of Article VI shows that the Parties did not intend to establish any hierarchy between Nicaragua's sovereignty over the river and Costa Rica's right of free navigation, characterized as "perpetual", with each of these affirmations counter-balancing the other. Nicaragua's sovereignty is affirmed only to the extent that it does not prejudice the substance of Costa Rica's right of free navigation in its domain, the establishment of which is precisely the point at issue; the right of free navigation, albeit "perpetual", is granted only on condition that it does not prejudice the key prerogatives of territorial sovereignty."[369]

6.18 Nicaragua quotes selectively from this paragraph of the Court's 2009 Judgment, suggesting that Costa Rica has "prejudiced 'the key prerogatives of [Nicaraguan] territorial sovereignty'" and is therefore "no more entitled to claim its 'perpetual' but conditional right of free navigation".[370] This assertion is without basis. Nicaragua's sovereignty, and Costa Rica's right of free navigation are each of them subject to the other.

6.19 In any event, as explained in Chapter 3 above, Nicaragua has not demonstrated that Costa Rica has in fact caused any actual harm to the San Juan River, let alone significant harm. There is therefore no evidence that

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368 1858 Treaty, as quoted in *Case Concerning the Dispute Regarding Navigational and Related Rights (Costa Rica v Nicaragua), Judgment, I.C.J. Reports 2009*, p. 236, para. 44.

369 *Dispute Regarding Navigational and Related Rights (Costa Rica v Nicaragua), Judgment, I.C.J. Reports 2009*, p. 237, para. 48.

370 NM, para. 6.36.

Costa Rica has "prejudiced 'the key prerogatives of [Nicaraguan] territorial sovereignty'", as Nicaragua asserts.

6.20 Nicaragua argues further that Costa Rica's right of navigation should be suspended as a consequence of Costa Rica's alleged breach of the 1858 Treaty, in accordance with the rule set down in Article 60 of the Vienna Convention on the Law of Treaties.[371] Article 60(1) of the Vienna Convention provides:

> "A material breach of a bilateral treaty by one of the parties entitles the other to invoke the breach as a ground for terminating the treaty or suspending its operation in whole or in part."[372]

Article 60(3) defines as material breach of a treaty as including "the violation of a provision essential to the accomplishment of the object or purpose of the treaty."[373]

6.21 According to Nicaragua "there can be no doubt that Costa Rica violated several provisions 'essential to the accomplishment of the object or purpose of the treaty'".[374] In particular, Nicaragua alleges two breaches of the 1858 Treaty: of Nicaragua's right of navigation;[375] and of the "obligation to notify".[376] According to Nicaragua, those breaches entitle it to suspend the operation of the 1858 Treaty, in whole or in part.[377] Costa Rica

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371 NM, para. 6.37.

372 Vienna Convention on the Law of Treaties, 22 May 1969 (entry into force on 27 January 1989) 1155 *UNTS* 331 (***Vienna Convention***), Article 60(1).

373 Vienna Convention, Article 60(3).

374 NM, para. 6.39.

375 NM, paras. 4.13-4.19.

376 NM, paras 4.20-4.27.

377 NM, para 6.39.

further contests Nicaragua’s misconceived and self serving interpretation of the 1858 Treaty of Limits. As explained in Chapter 4, the key provisions of this Treaty concern the establishment of a permanent and final boundary. No provision of this Treaty is relevant to Costa Rica's Road infrastructure works entirely within its own sovereign territory.

6.22 For the reasons given above, these Nicaraguan arguments must be rejected. Costa Rica’s right of navigation is not hierarchically inferior to Nicaragua’s sovereignty: they are co-existent. Costa Rica’s right of navigation cannot be suspended on the basis of breaches of the 1858 Treaty, which is a treaty establishing boundaries: since Costa Rica’s perpetual right of free navigation is intrinsically linked to Nicaraguan sovereignty over the waters of the San Juan, neither sovereignty nor the perpetual right of free navigation may be suspended. Both Nicaragua’s sovereign rights and Costas Rica’s rights of navigation form part of the boundary regime, and that regime is subject to the fundamental principle of stability of boundaries. As the Court affirmed in *Gabčíkovo-Nagymaros*, a treaty which establishes a territorial régime – including in respect of rights of navigation on rivers – is subject to the principle of stability as reflected for example in Article 12 of the Vienna Convention on Succession of States in Respect of Treaties.[378] The 1858 Treaty establishes such territorial régime and is therefore subject to the principle of stability of boundaries.[379] It may not be suspended.

378 *Gabčíkovo-Nagymaros Project (Hungary/Slovakia), Judgment, I.C.J. Reports 1997*, p. 72, para. 123, referring to Vienna Convention on Succession of States in Respect of Treaties, 23 August 1978 (entry into force 6 November 1996), 1946 *UNTS* 3, Article 12.

379 See, eg, *Case concerning the Temple of Preah Vihear (Cambodia v Thailand), Merits, Judgment, I.C.J. Reports 1962*, p. 34 (“In general, when two countries

6.23 In any event, as explained in Chapter 4, Nicaragua has failed to demonstrate that Costa Rica has breached any obligations under the 1858 Treaty. Nicaragua has failed to produce any evidence which demonstrates that the road infrastructure works have impacted on Nicaraguan navigation on the San Juan River in any way, let alone that its right to navigate on the River has been affected.[380]

6.24 In a single paragraph in its Memorial, Nicaragua asserts a third basis for suspension of Costa Rica's perpetual treaty right of free navigation on the San Juan River: viz. countermeasures.[381] Without reference to facts or authority, Nicaragua contends that suspension of Costa Rica's treaty is "'commensurate with the injury suffered' by Nicaragua, it fully 'permit[s] the resumption of performance of the obligations in question' and it should induce Costa Rica 'to comply with its obligations' to make good the harm suffered by Nicaragua."[382]

6.25 For the reasons given in paragraphs 6.18-6.21 above, and like Nicaragua's contention that Costa Rica's right of navigation should be suspended, this argument is without basis. Nicaragua's sovereignty and Costa Rica's right of free navigation are co-existent. Nicaragua cannot preserve its sovereignty while at the same time suspending Costa Rica's right of free navigation as a countermeasure.

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establish a frontier between them, one of the primary objects is to achieve stability and finality").

380 Cf. NM, paras. 4.13-4.19. See also Chapter 3 of this Counter-Memorial.

381 NM, para. 6.43.

382 NM, para. 6.43 (references to ILC Articles on State Responsibility omitted).

6.26 It follows that Nicaragua's request that the Court suspend Costa Rica's perpetual right of free navigation on the basis that Nicaragua is entitled to do so as a lawful countermeasure should be dismissed.

Submissions

For these reasons, and reserving the right to supplement, amplify or amend the present submissions, Costa Rica requests the Court to dismiss all of Nicaragua's claims in this proceeding.

Jorge Urbina Ortega
Co-Agent of Costa Rica

19 December 2013

APPENDIX A

Professor Colin Thorne

Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River

November 2013

Appendix A

DISPUTE CONCERNING

CONSTRUCTION OF A ROAD IN COSTA RICA ALONG THE SAN JUAN RIVER

(NICARAGUA V COSTA RICA)

Assessment of the Impact of the Construction of the Border Road in Costa Rica on the San Juan River

Prepared by

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December 2013

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1. Introduction

1.1. I am Colin Thorne, Professor of Physical Geography at the University of Nottingham. I have been requested by Costa Rica to prepare an independent expert report for the International Court of Justice (the ***Court***) in connection with the claim brought against Costa Rica by Nicaragua concerning the construction of a road in Costa Rica near the San Juan River (the ***Road***).

1.2. I am instructed to form an independent expert opinion on the matters set out in the Terms of Reference below.

1.3. I have reviewed the following documents:

(a) Report prepared by G. Mathias Kondolf entitled, *Environmental Impacts of Juan Rafael Mora Porras Route 1856, Costa Rica, on the Río San Juan, Nicaragua*, December 2012 (the ***2012 Kondolf Report***), which is Annex 1 to Nicaragua's Memorial in the Road Case;

(b) Nicaragua's Memorial of 19 December 2012 in the Road Case;

(c) G. Mathias Kondolf, Confirmation of Urgent Measures to Mitigate Erosion & Sediment Delivery from Rte 1856, Costa Rica, into the Río San Juan, Nicaragua, a report by Dr Kondolf dated 12 October 2013 (the ***Second Kondolf Report***);

(d) G. Mathias Kondolf, Continued Impacts of Erosion from Rte 1856, Costa Rica to the Río San Juan, Nicaragua, a further report by Dr Kondolf dated 30 October 2013 (the ***Third Kondolf Report***);

(e) G. Mathias Kondolf, Selected Photographs of Depositional Features along the Río San Juan de Nicaragua caused by Costa Rican Route 1856 Construction, Poor Design and Lack of Maintenance. Photos taken May 20-22, 2013 (***Appendix A***), which accompanies the Third Kondolf Report; and

(f) G. Mathias Kondolf, Comments on Costa Rican Submissions of November 2013, 6 November 2013 (the ***Fourth Kondolf Report***).

2. My Qualifications

2.1. Since 1990, I have held the Chair of Physical Geography at the University of Nottingham, United Kingdom (UK). I hold BSc (1974) and PhD (1978) degrees in Environmental Science from the University of East Anglia, UK. I have over 37 years of professional experience, including appointments at Colorado State University; the University of London; the U. S. Army Corps of Engineers, Waterways Experiment Station; and the U. S. Department of Agriculture, Agricultural Research Service, National Sedimentation Laboratory. I have published over 200 journal papers, conference papers and book chapters; authored two books; and edited a further seven. My research concentrates on fluvial and sediment processes in natural, modified, and managed rivers, particularly with respect to the implications for river erosion, sedimentation, and flood risk. I have performed original research and consultancy in the UK, USA, Argentina, Bangladesh, China, Ethiopia, Laos, and New Zealand, particularly involving large rivers and their coastal deltas.

2.2. My curriculum vitae is included as **Attachment 1** to this Report.

3. Terms of Reference and Methodology

A. Terms of Reference

3.1. I have been asked to provide an independent expert opinion on the environmental impacts of the Road on Nicaragua on the Río San Juan. In this context, I have been asked to review and assess the information and opinions given by Professor Kondolf in the reports listed in paragraph 1.3 above and the claims made by Nicaragua in *Construction of a Road* case relating to harm or potential harm to Nicaraguan territory.

3.2. I have been instructed to consider the potential environmental impacts of the Road on Nicaragua. Therefore, I have not addressed any impacts of the Road within Costa Rican territory.

B. Methodology

3.3. In preparing this Report, my approach has been as follows:

(a) I have reviewed the 2012 Kondolf Report, and the Second, Third and Fourth Kondolf Reports, and Nicaragua's Memorial insofar as it deals with harm or potential harm to the San Juan River and makes statements that rely on the 2012 Kondolf Report. I have also reviewed additional materials provided by Nicaragua in July 2013, including information relating to Professor Kondolf's estimates of annual rates of lowering of the land surface due to erosion associated with construction of the Road, delivery of some portion of the eroded sediment to the Río San Juan, and the coordinates of 54 "sediment input points" referred to on page 42 of the 2012 Kondolf Report.

(b) I have conducted a review of published academic literature on the hydrological, sediment and environmental impacts of road construction on rivers, including rivers in the Pacific Northwest of the United States of America that are mentioned in the Kondolf Report.

(c) I have participated in two site visits to the Road, on 15 and 16 February, and 7 May 2013. On the first occasion I drove along and/or viewed from the air the entire length of the Road. On the second occasion I drove to and reviewed from the air the first 41 km of the Road between Marker II and Boca San Carlos. During both site visits I undertook field observations, spoke to engineers and scientists engaged in mitigation works and took ground and aerial photographs;

(d) I have requested, formulated and supervised scientific and technical studies performed by qualified Costa Rican scientists and engineers, to elicit the data and information needed to evaluate the potential for construction of the Road to impact the Río San Juan;

(e) I have participated in technical meetings with the team of scientists and engineers on February 14 and 17, May 6 and 9-10, and July 30-31, during which we discussed approaches and methodologies to be employed in performing the work, reviewed progress and discussed the results of archive-based, field, remote-sensing, GIS-based research, and computer modelling; and

(f) I have reviewed the preliminary findings of the team, requesting additional analyses where appropriate.

(g) The technical reports have been produced and provided to me as the outcomes of this supervised research process are:

> Astorga, A. and Mende, A., *Route 1856: analysis of the change in land use based on satellite images before and after the construction of the border road*, August 2013 (***Land Use Change Report***), Annex 3 to Costa Rica's Counter-Memorial;
>
> Mende, A. and Astorga, A., *Inventory of Slopes and Water Courses related to the Border Road Nº 1856 between Mojón II and Delta Costa Rica*, October 2013 (***Inventory of Slopes and Water Courses***), Annex 6 to Costa Rica's Counter-Memorial;
>
> Mende, A., Astorga, A. and Chassot, O., *Evaluation of the 54 Sites of Purported Direct Sediment Delivery mentioned by Ph.D. Mathias Kondolf*, September 2013 (***54 Sites Report***), Annex 5 to Costa Rica's Counter-Memorial;

Costa Rican Institute of Electricity (ICE), SBC Projects and Associated Services, Centre for Basic Engineering Studies, Department of Hydrology, *Report on Hydrology and Sediments for the Costa Rican River Basins draining to the San Juan River*, August 2013 (***ICE Report***), Annex 4 to Costa Rica's Counter-Memorial; and

University of Costa Rica Centre for Research in Sustainable Development, Department of Civil Engineering, *Report on Systematic Field monitoring of Erosion and Sediment Yield along Route 1856*, September 2013 (***UCR Report***), Annex 1 to Costa Rica's Counter-Memorial

3.4. I have also reviewed the *Environmental Diagnostic Assessment (Ecological Component)* performed by the Tropical Science Center (***CCT Report***), Annex 10 to Costa Rica's Counter-Memorial. I am instructed that this Environmental Diagnostic Assessment was prepared pursuant to applicable requirements of Costa Rican law.

3.5. Where I rely on information and data contained in these reports and studies, or any other reports prepared in the course of the investigations and activities referred to in paragraphs 3.3 and 3.4 above, I indicate that I am doing so.

4. Nicaragua's statements concerning adverse impacts of the Road on the Río San Juan

A. Statements in Nicaragua's Memorial

4.1. In its Memorial, Nicaragua claims that:

> "it is evident that the construction of the road seriously affects the environment and the rights of Nicaragua. If the project is not ceased it would have irreversible and transcendental ecological and environmental consequences. Among the many consequences that can be highlighted are the following:
>
> 1. Dumping of trees and soil along the route of the road into the river flow, making more difficult and risking the navigation in its waters, over which Nicaragua has the dominion and sovereign jurisdiction based on the Treaty of 15th April 1858 and the Cleveland Award of 22nd March 1888.
>
> 2. Removal and sedimentation of fragile soils resulting in an increased and excessive sedimentation of the waters of the Nicaraguan river.
>
> 3. Impact over the hydrological resources, particularly affecting fishing in the river because of the changes in the quality of the water.
>
> 4. Destruction of the natural habitat of the bank by removing the immediate vegetation to the river flow for the construction of the road, affecting the tree diversity around it.
>
> 5. Interception of the natural flow of the waters that flow through the south basin to the San Juan River by modifying the drainage of the surrounding wetlands at the lower San Juan and its delta.
>
> 6. Erosion of the soil banks in places where a certain slope exists and resulting in the sedimentation of clay soils to the San Juan of Nicaragua River.
>
> 7. Decrease or alteration of the aquatic life due to the water cloudiness resulting from the sediments of the road construction.

8. Destruction of the inherent scenic values and eco-tourism potential of the river course."[1]

B. Statements in the 2012 Kondolf Report

4.2. In his 2012 Report, Dr Kondolf sets out the grounds for these claims by reference to the literature on the impacts of roads on rivers, expands upon the claims in detail and presents photographs, sketches and estimates of sediment volumes eroded and delivered to the Río San Juan annually (based on GIS analysis and opinion) to support the claims. He does not, however, provide any evidence to support claims of damage to ecosystems, navigability or ecotourism specific to the Río San Juan.

4.3. In summary, Dr Kondolf asserts that construction of the Road has already:

(a) decreased infiltration, increased surface runoff and distorted/diverted drainage in water courses and wetlands draining to the Río San Juan from the southern part of the basin, to disturb the natural hydrological regime of the river;

(b) delivered around 87,000 to 109,000 m^3 y^{-1} of additional sediment to the Río San Juan;

(c) increased significantly sediment concentrations and loads in the Río San Juan compared to pre-Road values, with adverse impacts on water quality, turbidity, morphology and the river environment both locally and downstream;

(d) caused significant damage to aquatic and wetland environments and navigability of the lower Río San Juan through causing excessive sedimentation.

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[1] NM, para. 2.31, quoting Diplomatic Note from the Minister of Foreign Affairs of Nicaragua, to the Minister of Foreign Affairs of Costa Rica, Ref: MRE/DVS/VJW/0685/12/11, 10 December, 2011, NM, Annex 16.

4.4. In his 2012 report, Dr Kondolf, predicts that, unless the measures he recommends to stabilise the road are taken, damage to the Río San Juan is certain to continue, accelerating by a factor of ten should a hurricane strike the area. In the conclusion to his report, Dr Kondolf states,

> "Importantly, the erosion and sediment delivery to the Río San Juan documented to date represent only a small fraction of the amount that is certain to occur during a hurricane or other large storm."[2]

4.5. Dr Kondolf's statement indicates that he believes the *potential* for erosion and sediment delivery to be much greater than any erosion and sediment delivery that has actually occurred since the Road was constructed. In essence he acknowledges that relatively little erosion and sediment delivery has occurred to date. Dr Kondolf attributes this to the fact that the period since construction of the Road has been drier than expected.

C. Geographical Extent of the Statements

4.6. It is clear from the statements made by Nicaragua (reproduced in paragraph 4.1 above) that the "transcendental" adverse ecological and environmental impacts referred to above would not be limited to the 108 km length of the Road where it is close to and parallels the Río San Juan, but would extend downstream throughout the basin. Conversely, the 2012 Kondolf Report focuses almost exclusively on the 41.6 km stretch of Road between Marker II and Boca San Carlos. The only reference to sediment delivery to the Río San Juan outside this stretch is oblique: Dr Kondolf reports observing sediment to have entered or be entering the Río San Juan at a total of 54 sites, 43 of which were located between Marker II and Boca San Carlos, but 11 of which were located in the longer (66.4 km) reach between Boca San Carlos and the Delta.[3]

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[2] 2012 Kondolf Report, p. 51.

[3] In his 2012 Report, Dr Kondolf referred to 54 sites where he says he observed direct delivery of sediment to the San Juan (see 2012 Kondolf Report, p. 7, para. 1.3.6 and p. 42, lines 3 and 4). Dr Kondolf did not identify the exact locations of these 54 sites in his 2012 Report. In response to a request for information, Nicaragua provided the coordinates of these 54 sites. They have been identified and analysed in the *54 Sites Report*.

4.7. In investigating whether there is actual evidence to support these claims of transcendental harm to the Río San Juan it is, therefore, essential to match the scope of the investigation to that of the claims. In this context, my Report considers the possibility of damage at both the river reach and river system scales. However, before doing so, I report in the next section my initial conclusions regarding the geographical scope of the 2012 Kondolf Report (and his further reports) and the extent of significant erosion issues along the Road, based on my own field observations in February and May of this year.

5. My Field Observations of the Road

A. Field Observations in February and May, 2013

5.1. As reported in the Introduction, I have visited the Road on two occasions this year. In this chapter, I report my over-arching impressions of the Road, especially in the context of Dr Kondolf's narrative, based on his inspection of that part of the Road that runs parallel to the border, which were made from a boat on the Río San Juan and a helicopter in Nicaraguan air space in October 2012.[4] I also observed some of the mitigation works, which are dealt with in Chapter 12.

B. My observations and Dr Kondolf's decision to limit his quantitative analysis to the upstream 41.6 km of the Road

5.2. Dr Kondolf has made several visits to the Rio San Juan in the vicinity of the Road, but as early as on Page 9 of his 2012 Report, Dr Kondolf introduces and explains his decision to limit assessment of road-related erosion and sediment delivery to the 41.6 km stretch of the Río San Juan between Marker 2 and its confluence of the with the Río San Carlos:

> "Due to time constraints, we completed this analysis only for the upstream 41 km of the road, upstream from the Río San Carlos confluence."

5.3. On the same page, he further notes that;

> "We treated this section with priority because it has the steepest topography overall."

5.4. In the event, Dr Kondolf not only prioritised this portion of the Road for analysis, he considered it exclusively. Dr Kondolf appears to have had insufficient time to estimate potential erosion rates and delivery ratios along the remaining 66.4 km of the Road between Boca San Carlos and Delta Costa Rica. Had he done so, he would have discovered that the steep topography in this area is unusual and contrasts markedly with that of what is much the longer part of the Road that

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[4] 2012 Kondolf Report, p. 1, para. 1.1; see also Third Kondolf Report, p. 1.

he was unable or chose not to analyse in detail. As a result, Dr Kondolf's 2012 Report delivers an unrepresentative and potentially misleading impression of:

(a) the propensity for and extent of road-related erosion,

(b) the potential for road-derived sediment to be delivered to the Río San Juan, and

(c) the possibility that road-derived sediment could have adverse impacts on water quality, sediment loads, morphology, environment, ecology or navigation in either the Río San Juan or the lower Río San Juan.

5.5. I base this conclusion on having viewed the entire length of the Road from the air plus having inspected the entire length of the Road along the Río San Juan (except for those stretches that either do not exist or are inaccessible by four wheel drive vehicle) during field visits made in February and May 2013.

5.6. Based on my first hand inspection of the Road on the ground it is clear that the erosion rates and sediment delivery ratios based on the 41.6 km of the road, upstream from the Río San Carlos confluence are unrepresentative of conditions along the remainder of the Road, where erosion rates are likely to be much lower and probably close to those extant prior to January 2011, and sediment delivery ratios are also likely to be lower than that suggested by Dr Kondolf.

5.7. This is the case not only because the terrain that the Road downstream of Boca San Carlos traverses is flatter, but also because construction of the Road followed a pre-existing road for a much greater proportion of its length, passing through areas that have long been inhabited and developed for pasture, crops, forestry and other uses with non-zero sediment yields. To support this conclusion, it is only necessary first to look at typical views from the air and the ground, demonstrated in photographs I took during my field visits (Figures 1 and 2) and, second, to examine the detailed maps of land use along a 1 km wide corridor around Route 1856 that were produced in a Geographical Information System (GIS), based on satellite images, aerial photographs and ground-truthing, by Astorga and Mende in the *Land Use Change Report*. In this context the quantitative results of Astorga and Mende's spatial analysis and conclusions based on those results are relevant.

5.8. According to their analysis, the area occupied by Route 1856 between Marker 2 and Delta Costa Rica is 350.2 ha, which represents 3.3% of the 10 447.2 ha area of a one kilometre wide corridor around the Road between Marker 2 and Delta Costa Rica.

5.9. Nearly three quarters (72.4% or 253.5 ha) of the area lost to the Road was used for pasture prior to construction of Route 1856 and so that land had already been cleared of natural vegetation and developed for agriculture.

5.10. Based on the detailed mapping, field work and spatial analyses performed in producing the maps presented in the *Land Use Change Report*, I conclude that the land use impacts of Route 1856 downstream of Boca San Carlos and outside the upstream 41.6 km that features prominently in each of Kondolf's Reports (2012 Kondolf Report, and Second, Third and Fourth Kondolf Reports) are mainly confined to low relief, pasture lands.

Figure 1. Photographs representative of conditions observed by the author along the Road between Boca San Carlos and Boca Sarapiquí on the ground on February 16, 2013.

Figure 2. Photographs representative of conditions observed by the author along the Road between Boca Sarapiquí and the Delta on the ground on February 16, 2013.

5.11. When viewed from the air, it is apparent that the cut slopes and fill prisms referred to frequently (and featured in many of the photographs) in the 2012 Kondolf Report as being significant areas of erosion are rare along the Road between Boca San Carlos and Boca Sarapiquí and are almost entirely absent between Boca Sarapiquí and the Delta (Figures 3 and 4). This personal observation is entirely consistent with the results recorded in the *Inventory of Slopes and Water Courses* by Mende and Astorga (2013), which is based on exhaustive field work combined with examination of satellite images, land-use change maps and helicopter overflights.

Figure 3. Photographs representative of conditions along the Road between Boca San Carlos and Boca Sarapiquí observed from the air by the author on February 16, 2013. The only slopes observed along the Road are in the catchment of the Río Cureña.

Figure 4. Photographs representative of conditions along the Road between Boca Sarapiquí and the Delta observed from the air by the author on February 16, 2013.

5.12. With regard to sediment input to the River, in his 2012 Report, Dr Kondolf reports having observed sediment eroded from the Road to have entered, or to be entering, the Río San Juan at 54 sites.[5] In response to a request from Costa Rica,

[5] 2012 Kondolf Report, p. 7, para. 1.3.6 and page 42, lines 3 and 4.

Nicaragua later provided coordinates for these 54 sites. This allowed the Costa Rican technical team to establish the precise locations of the 54 sites. Of the 54 sites, the majority (42) were found actually to be upstream of Boca San Carlos, with just 12 locations where road-derived sediment appeared to have entered or be entering the Río San Juan along the entire 66.4 km stretch extending downstream from Boca San Carlos to the Delta. The analysis undertaken by the Costa Rican team is reported in the *54 Sites Report* by Mende et al. (2013). This report further establishes that the coordinates of 7 of the 54 sites place them in Nicaraguan territory on the opposite side of the River to the Road. I take it that either these coordinates are blunders, or that they refer to the location of the helicopter rather than the point being observed. With respect to the Road downstream of Boca San Carlos, points 48 and 51 are in Nicaragua, leaving just 10 points of interest, only one of which is downstream of Boca Sarapiquí.

5.13. All of the points identified by Dr Kondolf which are on Costa Rican territory were investigated through field work and inspected using helicopter over flights during summer 2013. The complete results are available in the *54 Sites Report* by Mende et al. (2013), but the most salient findings are reported here for completeness.

5.14. Turning first to the 9 points listed by Dr Kondolf that lie between Boca San Carlos and Boca Sarapiquí on closer inspection, 7 of these appear to be of trivial significance or unrelated to the Road. The non-trivial points (49 and 50) refer to the confluence of the Rio Cureña and a nearby fill slope, respectively. As listed in Tables 13 and 14, and illustrated in Figure 31 below, the *Inventory of Slopes and Water Courses* and the *ICE Report* both indicate that the Cureña basin probably does contribute sediment to the River, but this reach is located downstream of the massive input of sediment from the Río San Carlos (estimated in Table 14 as being in excess of 4.5 million t y^{-1}), meaning that in comparison to the average annual sediment load of the Río San Juan in this reach (which is nearly 8 million tonnes). For the reasons explained in the subsequent sections of this report), these inputs of Road-derived sediment between Boca San Carlos and Boca Sarapiquí are insignificant.

5.15. Only one of Dr Kondolf's sites is located downstream of Boca Sarapiquí, at the mouth of the Caño Negro (C-109 in Medne and Asorga's 2013 *Inventory*). This crossing is stable, there are no cut or fill slopes in the vicinity and there is no evidence of even trivial delivery of sediment to the River. The River at this location (downstream of the major inputs from both the Rio San Carlos and Rio Sarapiquí), carries nearly 9 million tonnes of sediment annually (see Table 16 below). If Road-derived sediment does enter the Río San Juan via the Caño Negro it does so in quantities that are small in absolute terms and negligible in relative terms.

5.16. Based on my visits to and observations of the Road, backed up by detailed investigation of the 54 sites of sediment delivery referred to in the 2012 Kondolf Report by the Costa Rican technical team, I conclude that the Kondolf Reports say nothing about the Road downstream of Boca San Carlos because, with respect to the actual and potential delivery of road-derived sediment to the Río San Juan, there is nothing *to* say.

6. Characteristics of the Río San Juan

A. Introduction

6.1. The statements made by Nicaragua (summarised above in paragraph 4.1) and supported in the 2012 Kondolf Report (summarised above in paragraph 4.2) as well as the Second, Third and Fourth Kondolf Reports, suggest that the impacts of the Road on the Río San Juan extend to its hydrology, sediment concentrations and loads, morphology, environment and ecology. To assess whether there is evidence to support these statements, it is first necessary to examine and establish the characteristics of the Río San Juan with respect to each of these aspects of its form and process. That is the purpose of this Chapter of my Report.

B. Geologic, Tectonic and Topographic Controls on the Río San Juan

6.2. The natural characteristics of the catchment and drainage system of the Río San Juan are controlled by the geology and climate of its basin. Hence, this examination of those characteristics must start by reference to the structure and tectonics of the region. The account presented here is based on original and background research performed by Dr. Allan Astorga as part of technical studies related to preparation on my 2011 Report in the *Certain Activities* Case. The complete account of regional geology is presented in detail in a report to the Costa Rican Government (Astorga, 2011b). The material presented here is consistent with my précis in Thorne (2011), but it differs in that this summary covers the entire length of the River between Lake Nicaragua and the Caribbean Sea, whereas coverage in Thorne (2011) focused solely on geological controls on the bifurcation of the Río San Juan into the lower Río San Juan and the Río Colorado at Delta Costa Rica, and the effects of neotectonics on the gradient of the lower Río San Juan.

6.3. The geological-tectonic map of the Caribbean region published by Case and Holcombe (1980), shows that the basin of the Río San Juan consists of contrasting geologies separated by active fault lines (Figure 5).

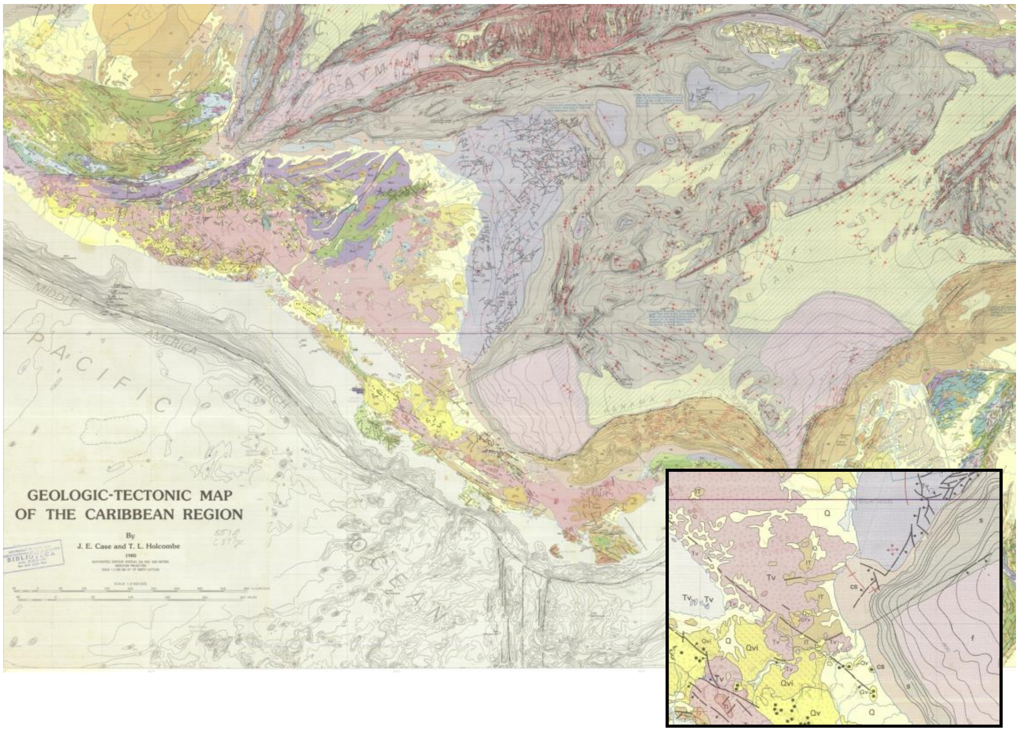

Figure 5. Geological-tectonic map of the Caribbean Region with enlargement showing the area in and around the basin of the Río San Juan (box in lower right of map).

6.4. The effects of geology and tectonics are evident in the regional terrain, as illustrated clearly in the Digital Elevation Model (DEM) reproduced in Figure 6. Based on the contrasting types and varying degrees of geologic and tectonic control exerted on the River, its channel and its floodplain, the Río San Juan may be divided into five, distinctly different reaches, described in detail in Table 1 and illustrated in Figure 7, which shows the five geologically-tectonically-topographically controlled reaches (including bed rock outcrops) superimposed on the long profile of the River, together with the DEM and a topographic map of the region.

6.5. It is vital to recognise and understand the significance of geology, tectonics and topography in influencing, and in some reaches constraining, fluvial processes and morphological responses to changes in the sediment supply in the Río San Juan, as will be explained in the remaining sections of this Chapter of my report.

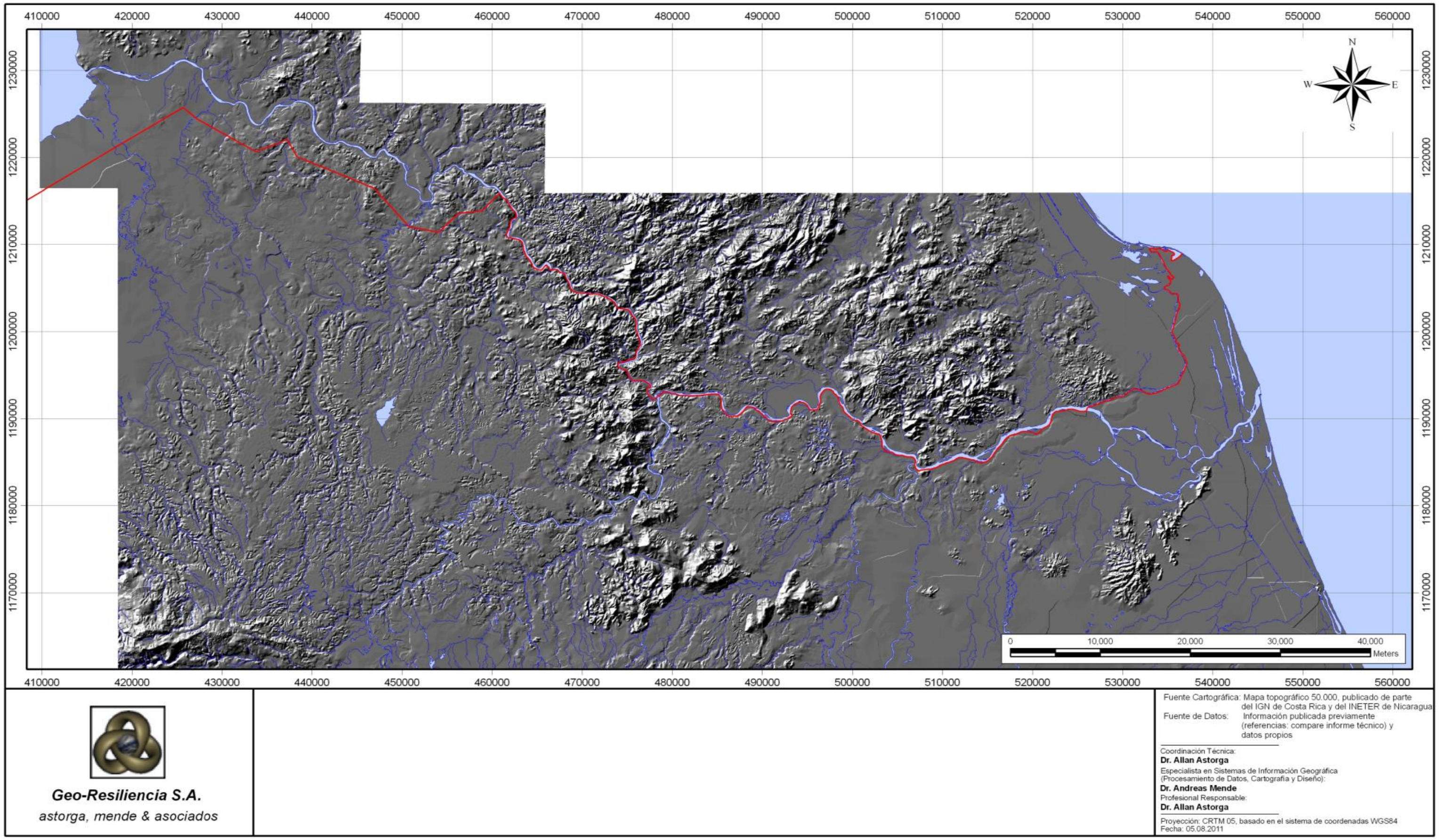

Figure 6. Digital Elevation Model (DEM) of area around the Río San Juan downstream of Lake Nicaragua (supplied by A. Astorga). The courses of the Río San Juan and other major rivers are marked in blue and the border is marked in red.

Table 1. Geologically defined reaches of the Río San Juan

Reach	Length (km)	Fall in Elevation (m)	Slope (m/m)	Description
Río Frio – Río Pocosol	52.86	6.5	0.007	In this reach the River flows across the floor of the structural geological basin that contains Lake Nicaragua. Consequently, it has a very low gradient, and its long profile is controlled by the first bed rock outcrop that forms rapids just upstream of the Río Pocosol confluence. The sediment load is low due to sediment retention in Lake Nicaragua and lack of large tributaries draining from steep basins.
Río Pocosol – Río San Carlos	52.67	7.7	0.008	In this reach the course of the River is constrained by hard rock geology. The elevation, long profile and slope of the River are controlled by bedrock outcrops that form rapids (see long profile and photograph in Figure 9). The alluvial floodplain is discontinuous, being alternately narrow or non-existent as the river is closely bounded on both sides by steep terrain formed in either intact rock or colluvial slope materials that are naturally resistant to fluvial erosion.
Río San Carlos - Río Sarapiquí	39.86	6.9	0.010	In this reach geological control is weaker because: there are no rock outcrops in the bed, the valley widens out considerably and the channel encounters hard rock and colluvium slopes less frequently, and the River receives large volumes of water and sediment from the Rio San Carlos. Consequently, the channel of the Río San Juan is steeper and closer to being alluvial (that is: self formed and responsive to fluvial processes) and the active floodplain is wider and more continuous.
Río Sarapiquí - Delta	22.04	3.8	0.010	In this reach the direction of the River changes because it comes under the control of the Hess-Santa Elena Fault. The River flows through a narrow valley bounded by high terrain of the Chortis Block to the north and the fault zone to the south. There are two rock outcrops in the bed that form rapids, but the naturally abundant supplies of water and sediment from upstream and from tributaries draining steep, volcanic catchments to the south maintain a steeper slope and make the channel and its floodplain semi-alluvial.
Delta – Caribbean Sea	32.35	5	0.009	In its lower reach below the Delta, the Rio San Juan flows north across the Chortis Block, which is being uplifted due to neotectonic action north of the Santa Elena - Hess Fault. As explained in detail in Thorne (2011), the lower Rio San Juan is flowing against the prevailing, neotectonic trends, which are for land north of the fault to continue rising, while that to the south continues to subside. Through time, the effect is to reduce the gradient of the lower Río San Juan and, hence, its capacity to transport sediment to the coast, leading to its channel tending to silt and lose conveyance capacity.

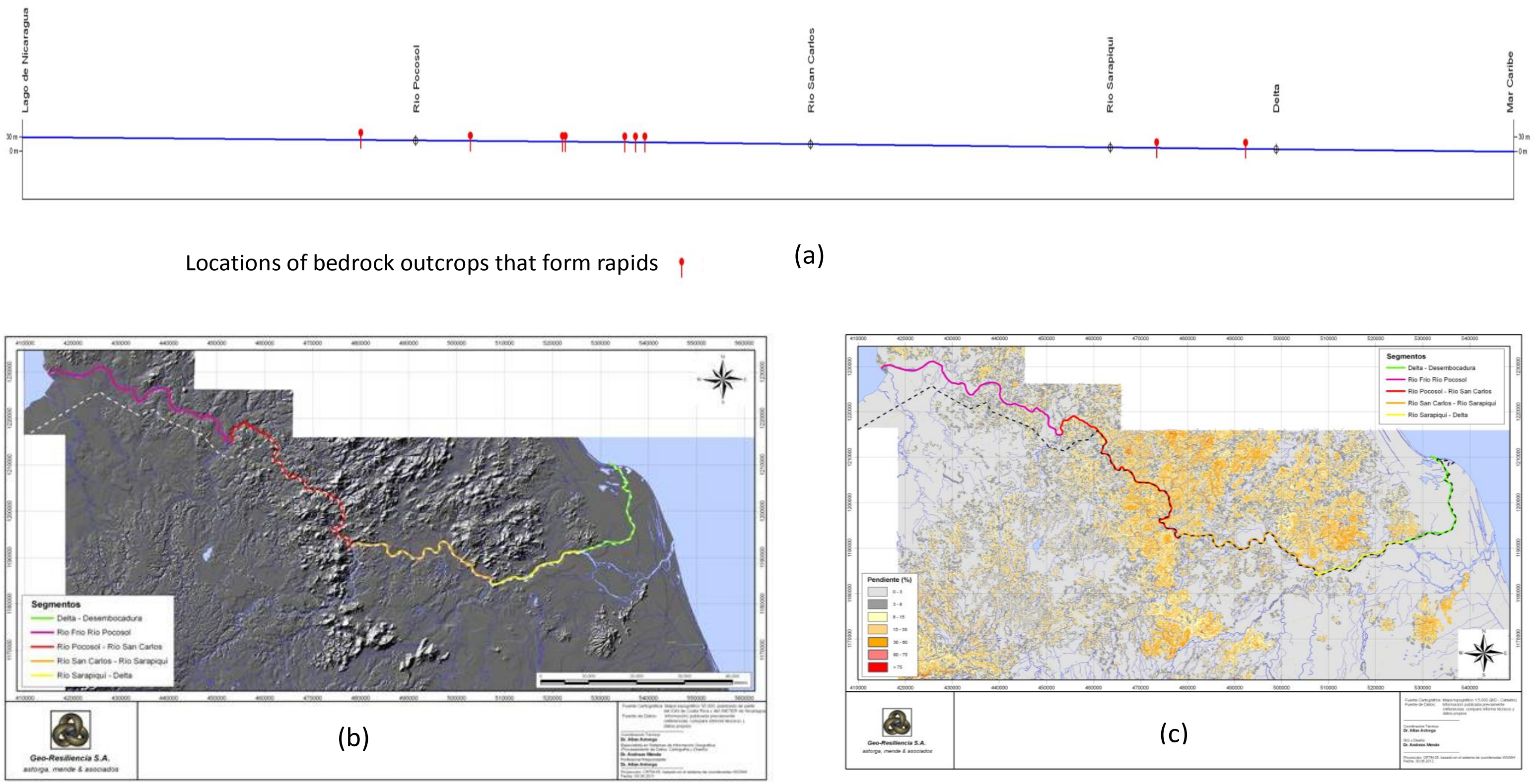

Figure 7. (a) Long profile of the Río San Juan between Lake Nicaragua and the Delta showing reach limits mentioned in Table 1 and locations of rapids caused by bed rock outcrops in the bed (see Figure 9 for an example) (b) DEM and (c) topographic map with five river reaches indicated.

C. Channel morphology and classification

6.6. The fact that the Río San Juan is not a conventional, alluvial stream has long been recognised. For example, in the 19th century, engineers surveying the River in exploratory investigations for a Trans-Oceanic Canal noted that the long-profile was almost uniform and that the bed upstream of Boca San Carlos featured multiple rapids associated with bed rock shoals that made the River difficult to navigate and canalize (Figure 8).

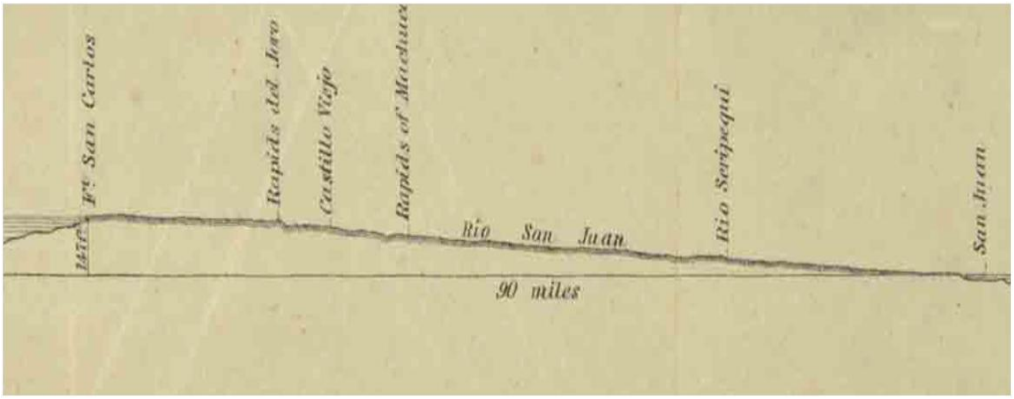

Figure 8. Long profile of the Río San Juan (from: Aguirre-Sacasa, Franciso 2002. "Un Atlas Histórico de Nicaragua", Colección Cultural de Centroamérica).

6.7. I observed several of these rapids during my field inspections in February and May 2013 (see Figure 9 for one example) and can confirm that they control both bed elevations and the long-stream gradient of the River in the reach between the tributary junctions of the Río Pocosol and Río San Carlos.

Figure 9. Example of rapids that control the bed elevation and long-stream slope of the Río San Juan between the confluence with the Río Pocosol and Boca San Carlos. These particular rapids are located just downstream of Río Infiernito tributary confluence.

6.8. It is only necessary to compare the long profile of the Rio San Juan (Figures 7a and 8) to that in a typical river (Figure 10) for the main difference to become obvious.

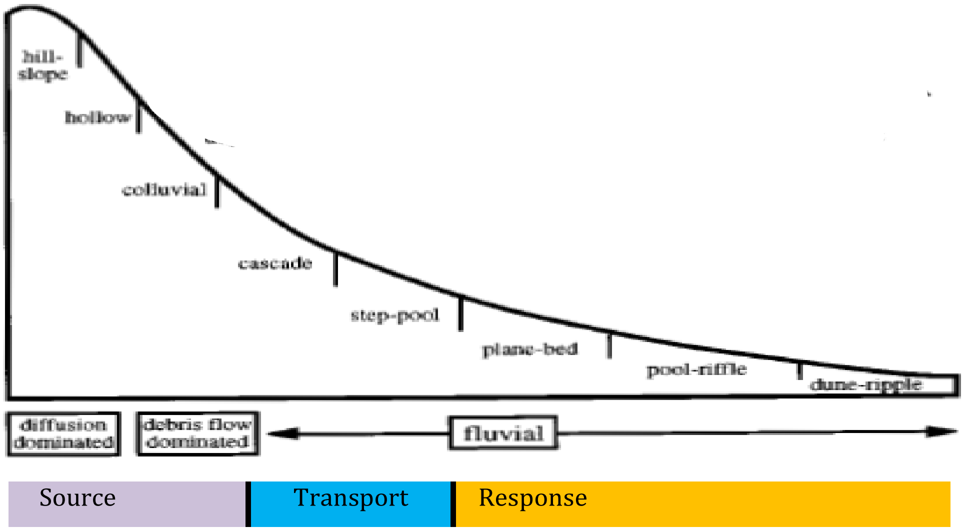

Figure 10. Typical river long profile from source to sea. Note the concave shape with a gradient that is steep in the upper course, gentle in the middle course and low in the lower course. Annotations represent the Montgomery-Buffington (1997) stream classes based on channel type and the ratio between sediment transport capacity and supply (see Figure 11). Modified from Montgomery and Buffington (1997).

6.9. In the case of the Río San Juan, the river is missing its steep, headwater 'Source' zone of hillslopes, hollows and colluvial reaches and the course downstream of Lake Nicaragua comprises only of 'Transport' and 'Response' reaches. This is because what would be the 'Source' zone of the Rio San Juan main stream is isolated from the River by Lake Nicaragua. The *de facto* sediment 'Source' zones are actually the headwaters of the major Costa Rican tributaries (and especially the Río San Carlos), as explained in the following sections of this chapter.

6.10. Montgomery and Buffington (1997) explain that the sensitivity of any reach to changes in the supply of sediment depends on the ratio between its capacity to transport sediment and the supply of sediment from upstream and local sources:

$$q_r = Q_c/Q_s$$

where, q_r = capacity/supply ratio, Q_c = sediment transport capacity and Q_s = sediment supply from upstream and local sources.

6.11. *Transport* reaches are morphologically resilient channels in which $q_r > 1$ and the actual rate of sediment transport is limited by the available supply rather than the capacity of the flow to carry sediment. Supply-limited conditions mean that the river has unfilled capacity to transport more sediment if it becomes available, giving the reach the capability to rapidly convey increased sediment loads downstream with little or no morphological response. *Transport* reaches typically feature a cascade of bedrock-controlled rapids or a step-pool bed controlled by large, rarely mobilized boulders.

6.12. *Response* reaches are morphologically sensitive channels in which $q_r < 1$ and the actual rate of sediment transport is limited by the capacity to transport sediment rather than the supply from upstream and local sources. Transport-limited conditions mean that the river has no unfilled capacity to transport additional sediment and morphologic adjustments are likely to occur in response to changes in sediment supply. *Response* reaches typically have alluvial beds featuring plane-bed, pool-riffle, or dune-ripple bedforms depending on whether the dominant bed materials are in the cobble, gravel or sand size ranges (Figure 11).

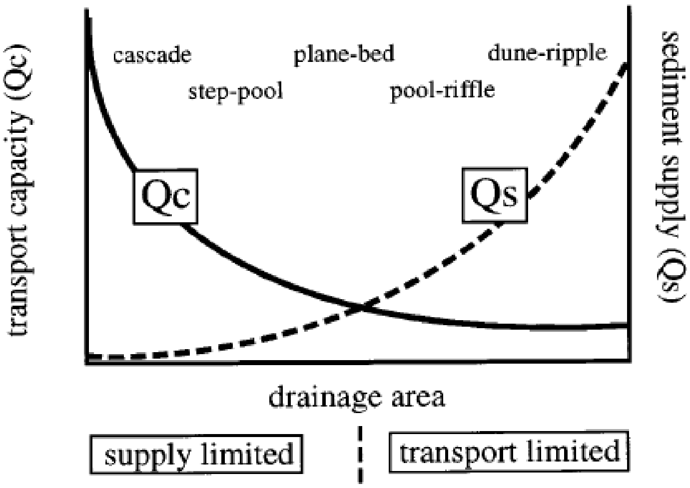

Figure 11. Schematic representation of downstream trends in relative sediment transport capacity (Qc) and sediment supply (Qs) in mountain rivers. From Montgomery and Buffington (1997).

6.13. My application of the Montgomery-Buffington classification to the Rio San Juan indicates that the first and second reaches (between Lake Nicaragua, Río Pocosol and Boca San Carlos) are *Transport* reaches (Figure 12) because the River in these reaches is controlled by a series of rapids (i.e. it is a cascade-type channel according to Figures 10 and 11). These reaches have ample sediment transport capacity to carry the relatively limited supplies of sediment from Lake Nicaragua and tributaries draining relatively small, low relief catchments with relatively low sediment yields.

6.14. The third and fourth reaches (between Boca San Carlos, Boca Sarapiquí and the Delta) are *Response* reaches (Figure 12). They are characterised by dune-ripple beds formed in mobile sand and high rates of sediment supply from large Costa Rican tributaries draining steep basins with active volcanoes. These inputs are roughly in balance with the high transport capacity of the River, though with a slight tendency for net deposition rather than erosion (see Figures 10 and 11).

6.15. The fifth reach is the lower Río San Juan below the Delta. This is a *Response* reach (Figure 12) in which the channel has a dune-ripple bed. Regional, neotectonic uplift of the Chortis Block (which lies to the north of the Santa Elena - Hess Fault) dictates that the transport capacity of the lower Río San Juan naturally decreases gradually through time, to drive a long-term depositional trend (see section II.2.1 of Thorne (2011) for a fuller explanation of this trend). According to my application of the Montgomery-Buffington classification, the Rio Colorado also constitutes a dune-ripple, *Response* reach, although regional tectonic subsidence south of the Santa Elena - Hess Fault means that the sediment transport capacity of the Rio Colorado naturally increases gradually through time.

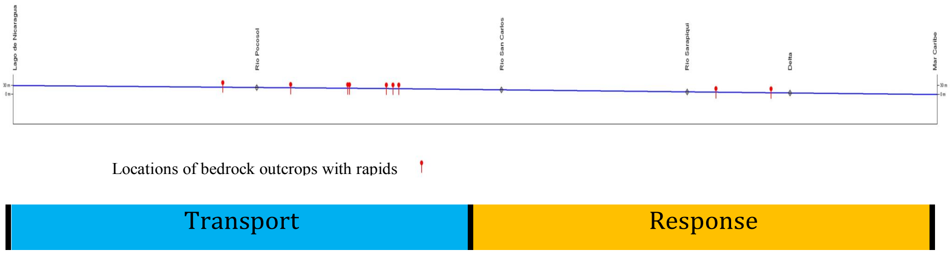

Figure 12. Designation of reaches of the Rio San Juan according to the Montgomery-Buffington classification.

D. Catchment Hydrology

(1) Rainfall Distribution

6.16. The climate of the region is dominated by atmospheric circulation in the Inter-tropic Convergence Zone (ICZ). The spatial distribution of rainfall in the Río San Juan basin exhibits the impacts of strong orographic effects associated with high mountains and volcanic peaks located along the southern margin of the catchment in the headwaters of large, northeast-flowing tributaries such as the Río San Carlos and the Río Sarapiquí (Figure 13a).

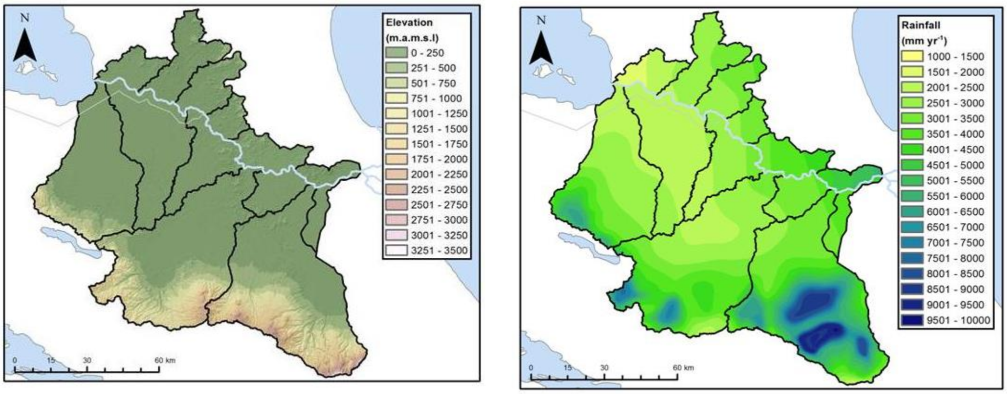

Figure 13. (a) Topographic map and (b) Distribution of mean annual rainfall in the catchment of the Río San Juan downstream of Lake Nicaragua. Note coincidence of heaviest rainfall with area of high relief along the southern margin of the basin in the headwaters of the Río San Carlos and Rio Sarapiquí (maps from 2013 ICE Report).

6.17. As a result, annual precipitation in the mountainous headwaters of rivers like the Río San Carlos and Río Sarapiquí is several times greater than that recorded close to and along the main stream Río San Juan in the vicinity of the Road (Figure 13b).

6.18. Seasonal effects influence the temporal distributions of both rainfall and runoff with the latter characteristically being high between July and December and low between March and May (Figure 14). Further details of regional climate and rainfall may be found in the ICE Report and the CCT Report.

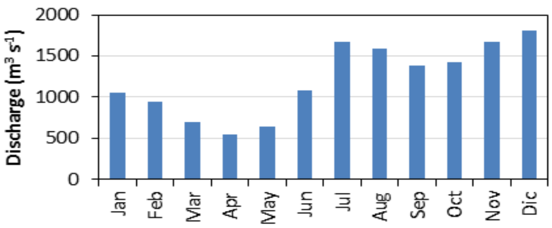

Figure 14. Monthly mean discharges measured in the Río San Juan main stream at Station 01-03, La Trinidad (from 2013 ICE Report).

6.19. In the 2012 Kondolf Report, Dr Kondolf refers on several occasions to the certainty that erosion from the Road will increase tenfold during the next hurricane or tropical storm. For example, on page 44, he states:

‘The intense rains that will inevitably occur during the next hurricane or other major storm will produce vastly greater erosion, mass wasting, and sediment delivery to the river.”

And this dire prediction is repeated on page 4 of the *Third Kondolf Report*:

> “There is no question that when intense rains associated with tropical storms and hurricanes occur, the damage will be widespread and severe.”

6.20. However, it is not inevitable or unquestionable that the Río San Juan will be struck by a hurricane or tropical storm. In fact, this would actually be unprecedented and it is therefore highly unlikely. According to the United States National Oceanographic and Atmospheric Administration website, there is no record of Costa Rica ever having been struck by a hurricane or tropical storm (Figure 15).

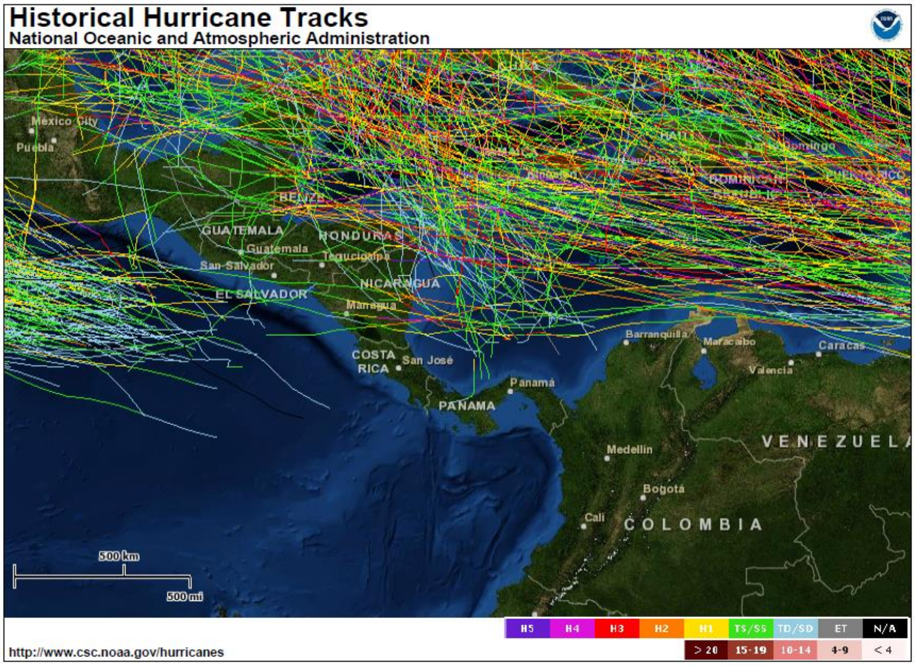

Figure 15. Historical hurricane tracks according to NOAA (from http://csc.noaa.gov/hurricanes/#).

It is true that Costa Rica has been affected in the past by hurricanes passing to the north of the country, For example, in respect of three relatively recent events, the Costa Rican National Meteorological Institute recorded rainfalls in the Rio San

Juan basin (in the area proximate to the Road) of between 20 and 250 mm (for Hurricane Joan); below 100 mm (for Hurricane Mitch); and between 15 and 150 mm (for Hurricane Stan).[6] In my opinion, rainfalls of this magnitude were in each event unexceptional and unlikely to cause widespread destruction because the basin of the Río San Juan receives abundant rainfall in most years and the hydrology, sediment dynamics, morphology and environment of the River are fully adjusted to the effects of frequent and heavy rainstorms.

6.21. On the other hand, if a hurricane or tropical storm were to strike the basin directly, there would likely be damage on a massive scale, including flooding and landslides affecting the entire region. In such a case, damage would be severe and extensive whether or not the Road existed.

6.22. But such an event would be unprecedented and, rather than being a certainty, the chance that a hurricane might cause significant erosion and sediment delivery from the Road is actually very small.

(2) Gauging stations and records

6.23. Gauged discharges for different periods of record are available for three gauging stations on the Río San Juan main stream and twelve stations distributed between the basins of the Ríos Frío, San Carlos and Sarapiquí in Costa Rica. In December 2010, a further station was established on the Río Colorado just downstream of the bifurcation, at Delta Costa Rica (Figure 16, Table 2).

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6 Letter from the General Director of the Costa Rican National Meteorological Institute to H.E. Edgar Ugalde Alvarez, 7 November 2013, Annex [xx] to Costa Rica's Counter-Memorial.

Table 2. Gauging stations on the Río San Juan - Colorado system and its Costa Rican tributaries (from ICE Report).

Station code	Station Name	River	Basin	Drainage Area (km^2)	Period of Record	Mean Annual Discharge ($m^3 s^{-1}$)	Active to date
01-01[a]	San Carlos	San Juan	San Juan	30 306[c]	1965-1986[c]	297[c]	No
01-02[a]	El Castillo	San Juan	San Juan	32 819[d]	1971-1981 1997-1998[b]	422[b]	No
01-03	La Trinidad	San Juan	San Juan	38 730[e]	1973-1976[e]	1123	No
11-04	Delta Colorado	Colorado	San Juan	-	2010-2013	1026	Yes
12-03	Puerto Viejo	Sarapiquí	Sarapiquí	845	1968-1999	113	No
12-04	Veracruz	Toro	Sarapiquí	191	1971-2013	26	Yes
12-05	Bajos del Toro	Toro	Sarapiquí	73	1985-1996	6.7	No
12-06	Toro	Toro	Sarapiquí	41	1993-2013	4.4	Yes
12-11	San Miguel	Volcán	Sarapiquí	59	1998-2002 2010-2013	11	Yes
12-13	Río Segundo	Segundo	Sarapiquí	17	1999-2013	2.7	Yes
14-02	Jabillos	San Carlos	San Carlos	552	1963-2013	51	Yes
14-04	Terrón Colorado	San Carlos	San Carlos	1556	1968-2008	166	No
14-05	Peñas Blancas	Peñas Blancas	San Carlos	293	1968-2013	35[f]	Yes
14-20	Pocosol	Peñas Blancas	San Carlos	124	1980-2013	19	Yes
16-02	Guatuso	Frío	Frío	253	1969-2013	28	Yes
16-05	Santa Lucía	Venado	Frío	34	1982-2013	3.9	Yes

[a]Stations installed, coded and operated by the INETER of Nicaragua. [b]INETER (2001). [c]INETER (2002). [d]INETER (2006). [e]ICE (1973). [f]Since 2002 the discharges are regulated by the Peñas Blancas hydropower plant.

(3) Mean Annual Discharge Regime of the Rio San Juan - Colorado System

6.24. The mean annual discharge regime of the Rio San Juan - Colorado system was established based on accounting for inputs from Lake Nicaragua and the main tributaries in Costa Rica and Nicaragua. This was achieved using the gauged data listed in Table 2 for the three main stream gauging stations, together with discharges calculated using the Area-Precipitation method for each of the Costa Rican tributaries.

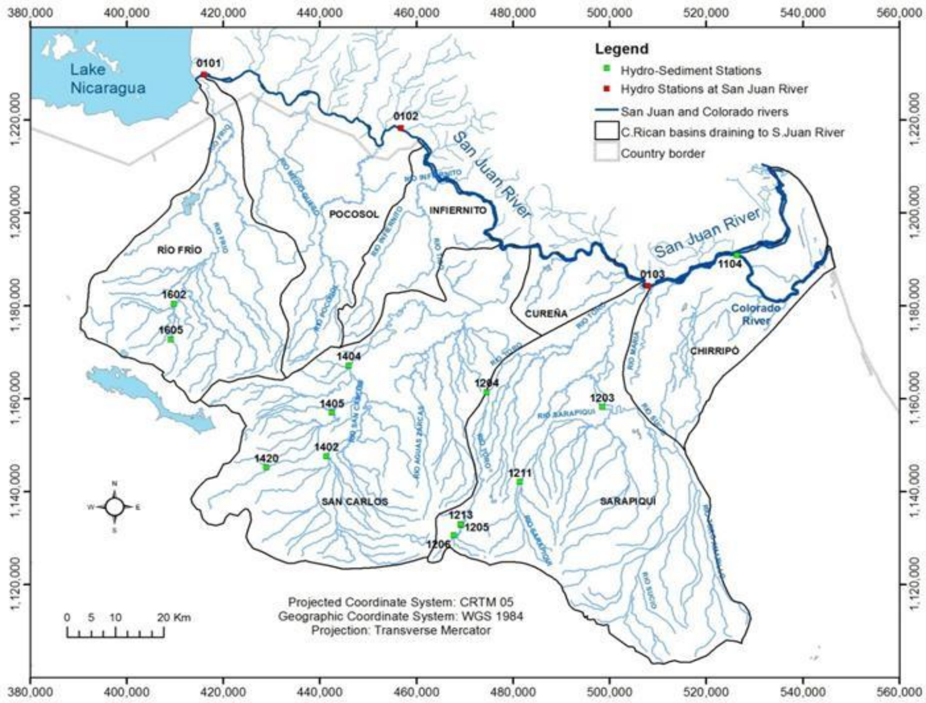

Figure 16. Gauging stations in the Rio San Juan basin (from ICE Report).

6.25. The Area-Precipitation method is a standard approach used by hydrologists to estimate discharges from un-gauged locations and catchments, based on synthetic rainfall-runoff relationships for data from gauging stations nearby. It was necessary to apply the Area-Precipitation method because the tributary gauging stations are located at varying distances upstream of their confluences with the main River, so that the gauged records are not directly equivalent to the discharges supplied to the Río San Juan, while other tributaries are entirely un-gauged.

6.26. The discharge balance was closed by estimating the mean annual discharge to the River from Lake Nicaragua as the difference between the discharge of Río San Juan measured at the San Carlos station (INETER, 2002) and the mean annual discharge of the Río Frío (ICE, 2010). The mean annual discharge input by Nicaraguan tributaries was estimated as the difference between the measured discharge of Río San Juan at La Trinidad station (ICE, 2011) and the sum of the inputs from Lake Nicaragua and all the Costa Rican tributaries (see Table 3 and Figure 17). As elements of the discharge regime have had to be obtained based the differences between gauged discharges, the figures in Table 3 are only indicative. They are still reasonable approximations, however, quite sufficient for the purposes of this Report.

Table 3. Discharge Regime of the Rio San Juan (from ICE Report).

Source	Mean Annual Discharge ($m^3 s^{-1}$)	Relative contribution (%)	
		Including Lake Nicaragua	Excluding Lake Nicaragua
Lake Nicaragua	185[a]	16	-
Costa Rican basins	783	70	83
Nicaraguan basins	155[b]	14	17
Total	1123	100	100

[a]Estimated as the difference between the discharge of San Juan River at San Carlos station (INETER, 2002) and the input from the Frío River basin (ICE, 2010). [b]Estimated as the difference between the discharge of San Juan River at La Trinidad station (ICE, 2011) and the sum of inputs from Lake Nicaragua and all the Costa Rican river basins

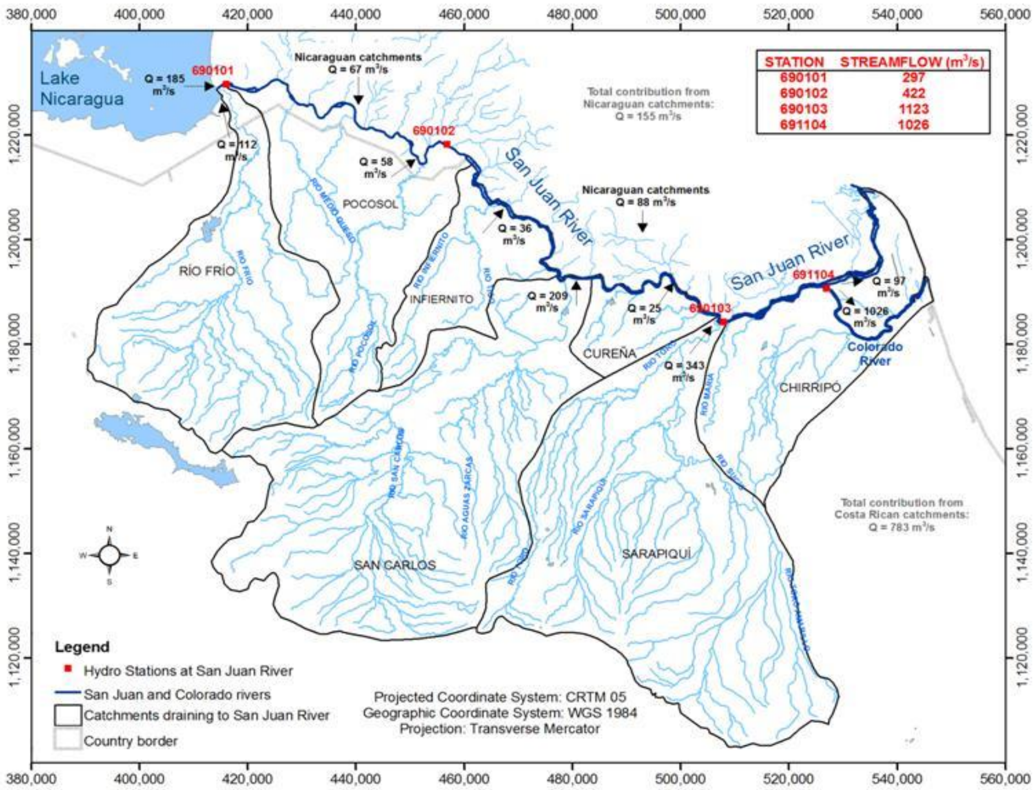

Figure 17. Discharge regime of the Río San Juan - Colorado system.

E. Sediment Regime

(1) Suspended sediment gauging stations and records

6.27. Suspended Sediment Concentration (SSC) has been measured using standard sampling procedures for different periods of record at thirteen stations operated by ICE and within the Río San Juan River drainage network in Costa Rica (Table 4). The values of average annual Suspended Sediment Load (SSL) listed in column 7 of Table 4 have been calculated by combining the SSC record with the average annual hydrograph for each station.

Table 4. Suspended sediment gauging stations along the main stream Rio San Juan and in Costa Rican tributary basins (from the ICE Report).

Station code	Name	Basin	River	No. samples	Sampling period	Ave. Annual Suspended load ($t\ yr^{-1}$)
01-03	La Trinidad	San Juan	San Juan	12	1974-1976	7 995 000
11-04	Delta Colorado	San Juan	Colorado	31	2010-2013	5 981 000[a]
12-03	Puerto Viejo	Sarapiquí	Sarapiquí	264	1970-1998	165 500
12-04	Veracruz	Sarapiquí	Toro	285	1972-2012	101 000
12-05	Bajos del Toro	Sarapiquí	Toro	137	1985-2001	50 000
12-06	Toro	Sarapiquí	Toro	117	1995-2010	20 500
12-11	San Miguel	Sarapiquí	Volcán	47	1998-2010	23 000
12-13	Río Segundo	Sarapiquí	Segundo	25	1999-2009	1 800
14-02	Jabillos	San Carlos	San Carlos	338	1967-2011	600 000
14-04	Terrón Colorado	San Carlos	San Carlos	53	1998-2009	1 300 000
14-05	Peñas Blancas	San Carlos	Peñas Blancas	308	1970-2011	157 000
14-20	Pocosol	San Carlos	Peñas Blancas	278	1980-2012	358 000
16-02	Guatuso	Frío	Frío	361	1970-2012	60 800
16-05	Santa Lucía	Frío	Venado	153	1984-2011	8 100

[a]Note: this is the average annual suspended load of the Río Colorado downstream of the Delta.

6.28. However, the only SSC record available for the Río San Juan main stream is that from La Trinidad (Station 01-03) between January 1974 and March 1976 (Line one in Table 4). I am instructed that these measurements were made jointly by Costa Rica and Nicaragua and their source is:

> Governments of Nicaragua and Costa Rica (1977). Central American Hydrological Project [PHCA], with the assistance of the United Nations Development Programme, San Juan River Hydroelectric and Navigation Project, December 1977, vol. 1, p. 69.

6.29. These data were cited in Nicaragua's Counter Memorial in the *Navigational Rights Case*, where Nicaragua said: “the sediment load immediately downstream from the Sarapiquí River, measured at the beginning of the seventies, was 10.2 million metric tons per year."[7] Given their provenance, and the fact that the data extend over more than a two year period, I conclude that they provide a reasonable indication of SSCs in the Río San Juan prior to construction of the Road.

6.30. The records reported in Table 4 include 2 409 individual measurements of suspended sediment concentration and these are plotted below in Figure 18.

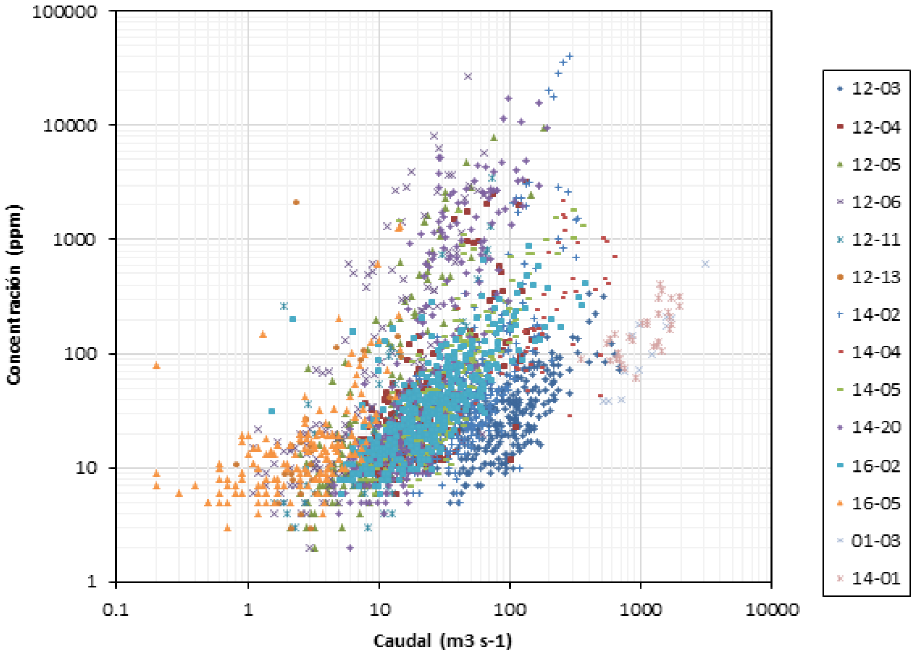

Figure 18. Suspended sediment concentration as a function of discharge for 2 409 samples taken from the Río Colorado, Río San Juan and its Costa Rican tributaries. Note: Station 14-01 in the legend refers to Delta Colorado (Station 11-04) in Table 4 (from the 2013 ICE Report).

6.31. SSCs measured in this large data set vary from less than 10 parts per million to more than 10 000 parts per million. This clearly illustrates the extreme natural variability in sediment concentrations, and associated levels of turbidity, characteristic of rivers in the Río San Juan – Colorado system. It should be noted that the wide range of SSCs is not an environmental or water quality problem – as

[7] See Nicaragua Counter-Memorial, *Navigational Rights Case*, para. 1.1.8.

demonstrated in the CCT Report, it is a long-standing fact of life to which the River's aquatic and riparian ecosystem is fully adapted.

(2) Measured and calculated bed load in the Rio San Juan - Colorado

6.32. Bed load is not routinely measured at most gauging stations, but 115 bed load samples were collected between December 2010 and June 2013 at the Delta Colorado station (11-04) and seven samples were also collected at the mouths of Río San Carlos and Río Sarapiquí. Details of the samples, including their particle size distributions, are reported in the ICE Report. The results demonstrate that bed load in Río San Juan – Colorado system is almost entirely composed of sand (Figure 19) confirming that the bed of the Río San Juan downstream of Boca San Carlos is formed in mobile, sand-sized sediment.

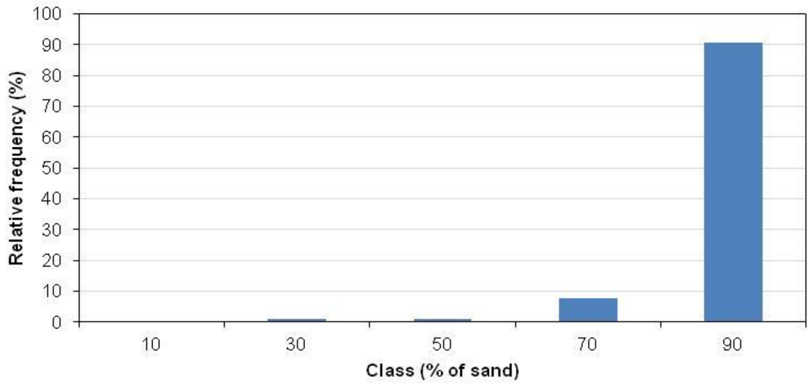

Figure 19. Frequency distribution of the sand percentages in all bed load samples, indicating that downstream of Boca San Carlos 90% of the bed of the Río San Juan is formed in mobile sand.

6.33. The measured bed load data are in themselves insufficient to estimate the average annual bed load of the Río San Juan, but it is well established that the Einstein bed load function can be used to contruct reliable bed load rating curves, provided that the equation is calibrated using measured data. Hence, the Einstein function was applied to produce a calibrated bed load rating curve for sand (that is particles larger than 0.063 mm) at the Río Colorado Station (11-04), using the 115 bed load measurements, the sampled median bed sediment size (D_{65} = 0.584 mm) and the hydraulic parameters relevant to a wide range of discharges (Figure 20).

6.34. The calculations are reported in the ICE Report.

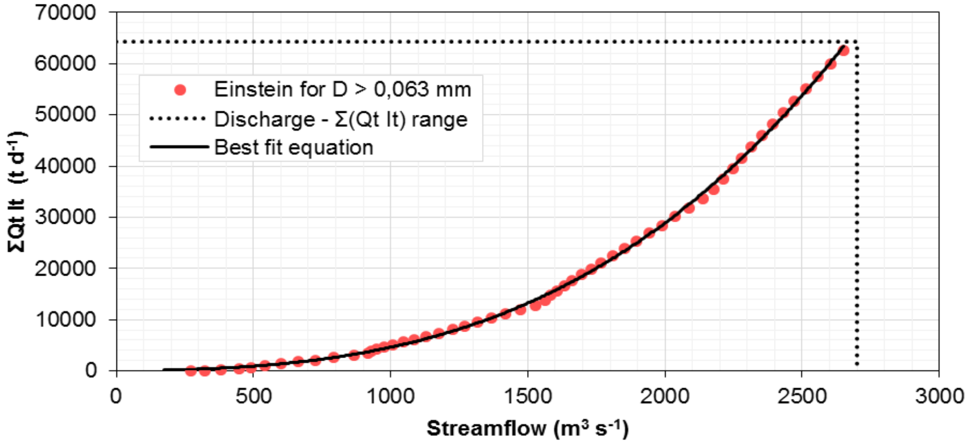

Figure 20. Bed load sediment rating curve for sand calculated by calibrating and applying the Einstein function to measured data from the Delta Colorado station (11-04) (from ICE 2013).

6.35. The average annual bed load transported by the Río Colorado was then calculated by combining the bed load rating curve with the hydrograph established by stream gauging at Station 11-04 between December 2010 and June 2013. The calculations are reported in detail in the ICE Report.

6.36. Using this method, the best estimate of the average annual bed load transported by the Río Colorado is 2 488 000 t y^{-1}. Given the uncertainties in the data, the 95% confidence interval on this best estimate is 2 340 000 to 2 595 000 t yr^{-1}.

6.37. The bed load rating curve for the lower Río San Juan just downstream of the Delta should be similar to that in the nearby by Río Colorado, and with this reasonable assumption, an average annual bed load of 71 000 t yr^{-1} was calculated for the Lower Río San Juan, with a 95% confidence interval of 66 600 to 73 800 t yr^{-1}.

6.38. Applying the law of sediment continuity, the average annual rate at which bed load is transported by flow in the Río San Juan approaching the Delta must match the sum of the loads calculated for the Colorado and Lower San Juan, suggesting that the average annual bed load in the main stream Río San Juan should be about 2 559 000 t yr^{-1}, with a 95% confidence interval of 2 406 600 to 2 668 800 t yr^{-1}.

6.39. Estimated average annual bed loads in the Río San Juan – Colorado system are summarised in below, in Table 5.

Table 5. Current average annual bed loads in the Río San Juan – Colorado (compiled from the ICE Report)

River	Period	Average Annual Bed Load (t yr^{-1})	
		Best Estimate	Upper and lower bounds
Río San Juan	2010 - 2013	2 559 000	2 406 600 – 2 668 800
Río Colorado	2010 - 2013	2 488 000	2 340 000 – 2 595 000
Lower Río San Juan	2010 - 2013	71 000	66 600 – 73 800

(3) Average annual total sediment loads in the Río San Juan – Colorado

6.40. The suspended and bed loads calculated in sections E (1) and E (2) above for the period December 2010 to June 2013 may be added to indicate the total sediment loads in the rivers of the Río San Juan – Colorado system. The results are listed below, in Table 6.

Table 6. Current average annual total loads in the Río San Juan – Colorado (compiled from data presented in the ICE Report)

River	Suspended load t y^{-1}	Bed load t y^{-1}	Total Load t y^{-1}
San Juan	6 573 000	2 559 000	9 133 000
Colorado	5 981 000	2 488 000	8 470 000
lower San Juan	592 000	71 000	663 000

F. Contrasts between the Río San Juan and rivers in the Pacific Northwest

6.41. In the literature review in section 3.1.4 of the 2012 Kondolf Report, the adverse impacts of roads on rivers are illustrated primarily by use of examples from the West coast of the USA. Dr Kondolf cites and quotes from a considerable body of literature in explaining how road building in the twentieth century supplied massive amounts of sediment to water courses such as the Quinault

River, Clearwater River, and Redwood Creek, leading to reduced water quality, unprecedented sedimentation, and deterioration in aquatic and benthic habitats that led to the collapse of the salmon populations in these water courses. However, as I will demonstrate below, there are some caveats to the simple message he delivers that road building in northern California, Oregon and Washington drove salmon to the point of extinction and, in any case, what happened in these rivers has no relevance to the Río San Juan, because (as is clear from the CCT Report), there are no salmon in the Río San Juan.

6.42. Without trying to defend the totally inappropriate actions taken and damage done to rivers in the Pacific Northwest, which were indeed regrettable, it is worth citing some further literature and making counter-points on road construction and near extinction of the 'King of Fish'.

6.43. The first point is that the scale of road building in the catchments mentioned by Dr Kondolf was extensive – far more so than in the case of the Road constructed by Costa Rica. According to Montgomery (1994a; 1994b), in many catchments in the Pacific Northwest the road density resulting from the 20th century forest road building campaign rivaled in extent the length of the stream network itself, with as much as 60% of the newly constructed roads being directly connected to the stream networks within the basins affected. The effect was for road construction to increase drainage density by 50% or more, with the understandably marked impacts on catchment hydrology and sediment yields noted earlier by Reid and Dunne (1984), which are cited by Dr Kondolf in his Third Report. By contrast, the total length of Route 1856 is a tiny fraction of the length of the extensive channel networks in the Costa Rican tributary basins, and is infinitesimal in the context of the drainage network of the Río San Juan itself.

6.44. A further comparison that explains why the impacts of road building observed in the examples cited by Dr Kondolf cannot be compared to those in the Río San Juan is to consider the paper published by Cedarholm et al. (1982), who found that roads covering 4% of the overall surface area of the Clearwater River increased sediment production and delivery to channels by 400%. This is indeed a massive increase and one that would be expected to have significant impacts on the receiving waters. However, if we apply that same proportionality to Route 1856, a different outcome emerges. Let us assume that, as in the case of the Clearwater River, covering 1% of a basin in roads increases sediment delivery by 100%. The basin area of the Rio San Juan is close to 40 000 km^2 while, according to the mapping performed by Astorga and Mende in the *Land Use Change Report*, the area of the Road (including cut slopes, fill slopes and all other disturbed areas) is about 3.5 km^2. The Road therefore covers only 0.00875% of the area of the basin. It follows, that in the case of the Road along the Rio San Juan, the expected increase in sediment delivery to the Río San Juan should be around 1%. As I show later in paragraph 8.56 of this report, that estimate is actually very close to the mark. Yet the measured data reported above in section 6.E establish that natural variability in the sediment load is around +/-20%: that is, far greater than 1%, so such an increase would have no impact whatsoever and would, in fact, be undetectable. If the example of road building in the Clearwater River has value as comparator to construction of Route 1856, that value lies not in portending similarly damaging impacts in the Río San Juan but reassuring us that any increase in sediment load due to construction of is bound be tiny.

6.45. Another major difference between tropical rivers in Central America and the examples used by Dr Kondolf is that the Pacific North West rivers are cold-water streams with naturally low concentrations of Total Suspended Solids (***TSS***). Between storm runoff events turbidity in these rivers is minimal - hence names like the "Clearwater River". In contrast, the Río San Juan is a warm-water stream with high naturally high concentrations of suspended sediment and organic material that persist even during base flow. The high TSS concentration is what makes the water turbid and gives the River the characteristic green-brown colour that is evident in true colour photographs and satellite images. Fish and other aquatic organisms in the Río San Juan do not find high turbidity problematic because they are fully adapted to it. On the contrary, a reduction in turbidity would be more likely damage the aquatic ecosystem of the Río San Juan through, for example, unnaturally revealing to predators the location of prey species.

6.46. The final point that is unclear from Dr Kondolf's literature review is that road building was just one of multiple factors responsible for the decline of salmon in the rivers of the Pacific North West.

6.47. First, loss of Large Woody Debris due to cleaning of stream channels and catchment forest clear cutting was far more important as a fundamental driver of environmental change in Pacific North West rivers than was road construction, in all but the areas with the steepest terrains. Loss of Large Woody Debris leads to extensive impacts on river morphology and habitat complexity (e.g. wetted channel area, size, number and depth of pools, number of side channels etc.). It is now generally recognised that changes in habitat character, loss of key habitats (e.g. pools) and reduction in habitat diversity and floodplain connectivity were primary causes the decline in salmon (Montgomery et al. 1995, Collins and Montgomery 2002, Collins et al. 2002, Collins et al. 2012).

6.48. Second, Chapman (1988) and Lisle (1989) established that increased fine sediment infiltration into previously clean river bed gravels adversely affects salmon survival because their eggs incubate within the gravel. But the fish species that inhabit the Río San Juan do not bury their eggs in clean gravel beds. Therefore, this mechanism by which the salmon fishery in California, Oregon and Washington was damaged is completely irrelevant.

6.49. Third, salmon are anadromous – meaning that they migrate between the river and the ocean, actually spending most of their lives at sea. Pess et al. (2002) showed that changes in the river environment accounted for only about half of inter-annual variability in Coho salmon abundance in the Snohomish River, with factors related to that part of the fish's life cycle dependent on ocean conditions accounting for the other half. Hence, the decline of salmon in the Pacific Northwest is probably related as much to pressures on the population at sea (climate change and over-fishing) as it is to changes in river environments.

6.50. Finally, perhaps the biggest *single* cause of the decline of pacific salmon has been dam building - which blocks the passage of anadromous fish between their headwater spawning streams and the sea; an impact which fish ladders have failed to alleviate and fish hatcheries seem to have compounded.

6.51. In summary, road building was a leading contributor to the decline of salmon in the Pacific North West only in some very steep drainage basins where road construction was particularly extensive, such as in the Clearwater and Quinault basins quoted by Dr Kondolf. In most American west coast rivers the decline of salmon must be blamed primarily on dam construction, overfishing, hatcheries, hydrological changes due to urban expansion, and loss of Large Woody Debris due to stream cleaning and basin-wide forest clear cutting (Nehlsen et al. 1991, Montgomery 2003, esp. Chapters 1-3, 10 and 11). These factors are simply irrelevant to assessment of the impact of the Border Road on the Río San Juan.

G. Appearance of the Río San Juan in 2009 in Figures 4 and 5 of the Kondolf Report

6.52. In the 2012 Kondolf Report, it is stated on page 7 that,

> "Spatial Solutions of Bend, Oregon USA) supplied the following imagery of the river and road corridor through the study area:
>
> Pleaides Satellite pan-sharpened multi-spectral imagery with 50cm resolution for September-October 2012; and
>
> RapidEye Satellite multi-spectral imagery with 5m resolution acquired December 2009."

6.53. Selected parts of these images were used in Figures 4 and 5 (on page 18 of the 2012 Kondolf Report) to illustrate conditions before (2009) and after (2012) construction of the Road. Figures 4 and 5 from the 2012 Kondolf are reproduced below as Figures 21(a) and 22(a), respectively.

6.54. In June 2013, on Nicaragua's suggestion,[8] I requested from Jeff Campbell of Spatial Solutions, Bend Oregon, duplicate copies of the December 2009 RapidEye satellite images supplied to Nicaragua in 2012. Mr Campbell attested that the images supplied to me are identical to those supplied to Nicaragua. They are

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[8] Costa Rica requested copies of the satellite imagery used in the 2012 Kondolf Report. Nicaragua refused to provide them but indicated that these could be obtained from the commercial vendor, Spatial Solutions.

reproduced in Figures 21(b) and 22(b) (below Figures 4 and 5 of the 2012 Kondolf Report) for comparison.

6.55. When the images depicting pre-Road conditions in 2009 in Figures 4 and 5 from the 2012 Kondolf Report (Figures 21(a) and 22(a)) are compared with the true colour satellite images supplied by Spatial Solutions (Figures 21(b) and 22(b)) this reveals that the hue in Figures 4 and 5 of the 2012 Kondolf Report depicting pre-Road conditions differs from that in the original images. This is especially evident in the colour of the pre-existing road (marked in both Figures 4 and 5) and that of the River itself. In December, at the height of the wet season, the Río San Juan River is high (see Figure 14, above) and characteristically brown – as it appears in the original RapidEye images.

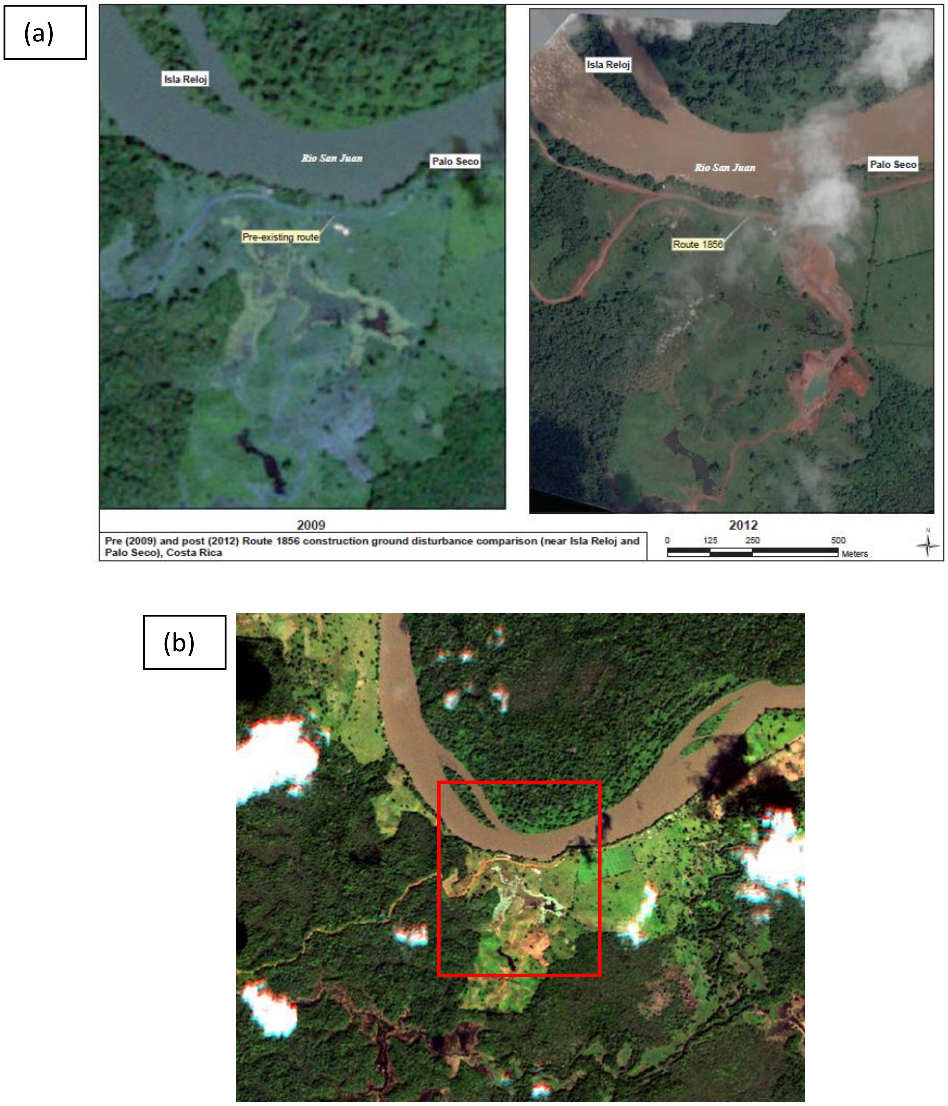

Figure 21. (a) Figure 4 from page 18 of the 2012 Kondolf Report. (b) Rapideye image of areas around Isla Reloj – Palo Seco in 2009 supplied to Nicaragua by Spatial Solutions and in Figure 4 of the 2012 Kondolf Report. Red box indicates the area depicted in the left (2009) image in Figure 4 of the 2012 Kondolf Report. I obtained this image from Spatial Solutions in June 2013. Mr Jeff Campbell of Spatial Solutions supplied both images and he attested to me that the image in (b) is an exact duplicate, identical to the image he supplied to Nicaragua in 2012 - which was used to produce the left hand (2009, pre-Road) image in (a).

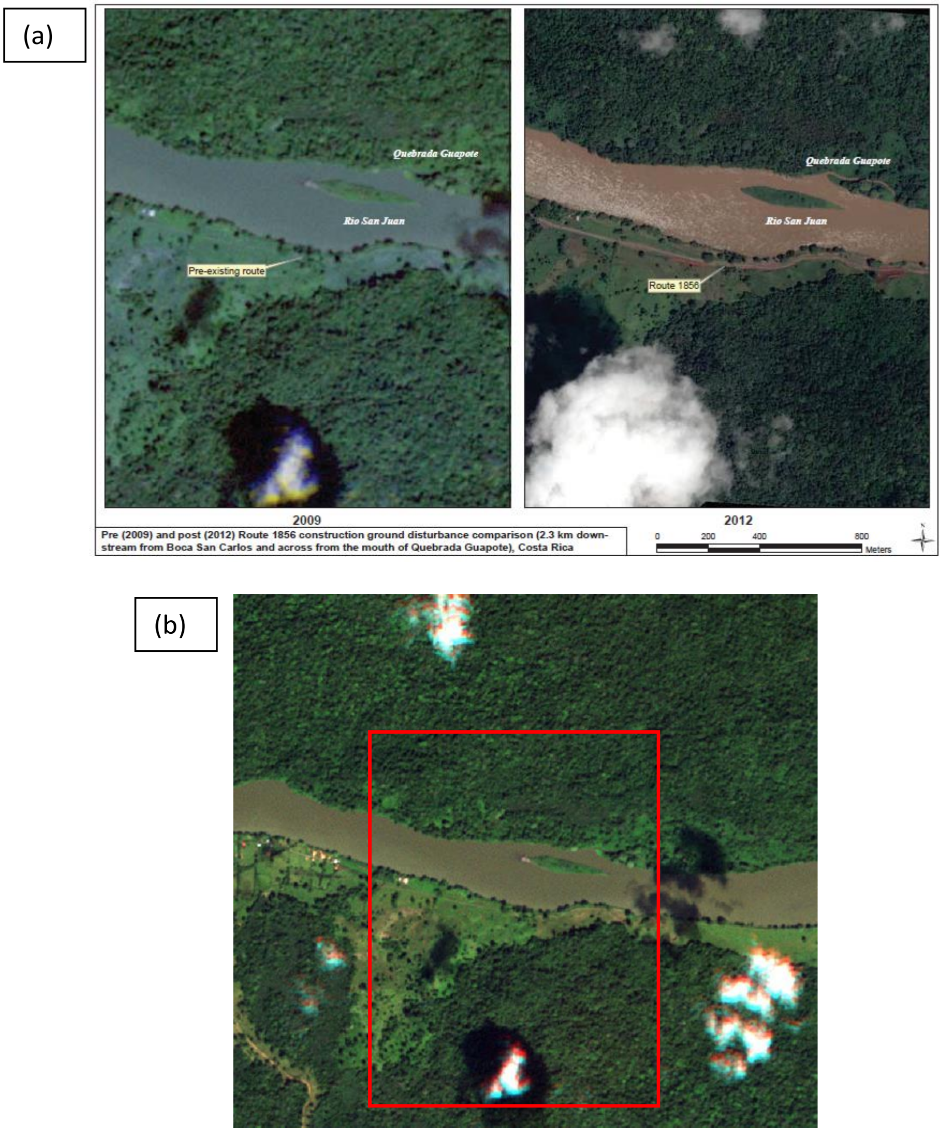

Figure 22. (a) Figure 5 from page 18 of the 2012 Kondolf Report. (b) Rapideye image of area around 2.3 km downstream from Boca San Carlos and across from the mouth of Quebrada Guapote in 2009, supplied to Nicaragua by Spatial Solutions and used in Figure 5 of the 2012 Kondolf Report. Red box indicates the area depicted in the left (2009) image in Figure 5 of the 2012 Kondolf Report. I obtained this image from Spatial Solutions in June 2013. Mr Jeff Campbell of Spatial Solutions supplied both images and he attested to me that the image in (b) is an exact duplicate, identical to the image he supplied to Nicaragua in 2012 - which was used to produce the left hand (2009, pre-Road) image in (a).

7. Has Route 1856 altered the hydrology of the Río San Juan?

A. Overview

7.1. This Chapter reports the results of analyses performed to ascertain whether construction for Route 1856 has impacted the hydrology of the Río San Juan. The necessary analyses were performed by Costa Rican hydrologists and engineers at ICE and are reported in the ICE Report. The investigation was undertaken in two stages. First, the increase in impermeable area within each of the major and micro-basins draining from Costa Rica to the Rio San Juan was measured using a GIS. Second, the hydrological regimes of the basins prior to and following construction of Route 1856 were simulated using hydrologic modelling.

B. Increases in impermeable areas due to construction of Route 1856

7.2. In performing this analysis, consideration of the hydrology of Costa Rican basins draining to the Rio San Juan was extended to include not only the seven major tributaries reported in Section 6 D[2] but also eighty micro-basins draining to the Río San Juan between Marker II and Delta Costa Rica that would, in practice, be most likely to exhibit the hydrological impacts of the Road, if there were any. The major and micro-basins (highlighted in grey) are shown in Figure 23 and their parameters are listed in Table 7.

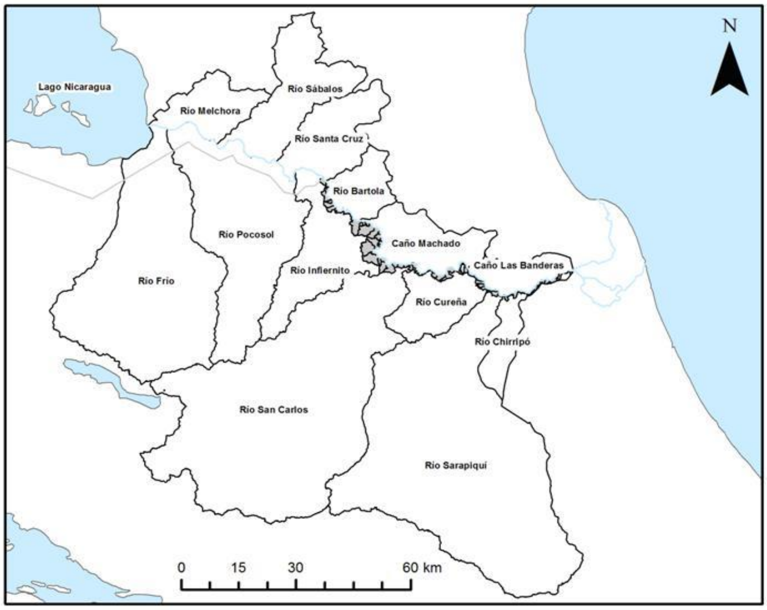

Figure 23. Major tributary basins and micro-basins (highlighted in grey) draining from Costa Rica to the Río San Juan between Marker II and the Delta.

Table 7. Maximum possible increases in impermeable area due to construction of Route 1856 within micro-basins and major tributary basins draining from Costa Rica to the Río San Juan (from 2013 ICE Report).

Basin	Area (km^2)	Impermeable Area (km^2)	Change (%)	Basin	Area (km^2)	Impermeable Area (km^2)	Change (%)
Micro-basins between Marker II and Delta C.R.				*Micro-basins between marker II and Delta C.R.*			
Basin 01	2.00	0.109	5.40	Basin 46	0.88	0.012	1.33
Basin 02	1.05	0.067	6.40	Basin 47	0.42	0.005	1.25
Basin 03	0.41	0.014	3.30	Basin 48	0.70	0.006	0.80
Basin 04	1.05	0.047	4.50	Basin 49	0.39	0.001	0.36
Basin 05	1.45	0.019	1.30	Basin 50	1.68	0.030	1.76
Basin 06	2.20	0.030	1.40	Basin 51	0.61	0.020	3.33
Basin 07	0.93	0.006	0.60	Basin 52	1.57	0.011	0.69
Basin 08	3.30	0.124	3.70	Basin 53	0.50	0.007	1.47
Basin 09	2.68	0.033	1.20	Basin 54	0.92	0.011	1.20
Basin 10	0.40	0.021	5.30	Basin 55	0.56	0.005	0.96
Basin 11	1.69	0.078	4.60	Basin 56	4.93	0.080	1.63
Basin 12	1.12	0.122	10.90	Basin 57	1.66	0.034	2.08
Basin 13	0.69	0.097	14.00	Basin 58	1.60	0.033	2.07
Basin 14	0.61	0.073	12.10	Basin 59	1.16	0.037	3.16
Basin 15	8.12	0.117	1.40	Basin 60	1.47	0.028	1.88
Basin 16	1.01	0.025	2.40	Basin 61	1.70	0.092	5.42
Basin 17	0.83	0.025	3.00	Basin 62	0.76	0.029	3.78
Basin 18	1.08	0.067	6.20	Basin 63	0.40	0.013	3.26
Basin 19	9.77	0.081	0.80	Basin 64	3.53	0.035	0.98
Basin 20	0.68	0.076	11.30	Basin 65	2.83	0.093	3.29
Basin 21	5.24	0.055	1.00	Basin 66	2.43	0.051	2.10
Basin 22	0.68	0.050	7.40	Basin 67	0.38	0.016	4.34
Basin 23	2.09	0.052	2.50	Basin 68	1.26	0.067	5.31
Basin 24	0.86	0.009	1.00	Basin 69	0.68	0.029	4.24
Basin 25	0.63	0.010	1.60	Basin 70	1.49	0.004	0.30
Basin 26	5.50	0.018	0.30	Basin 71	1.58	0.055	3.47
Basin 27	10.27	0.006	0.10	Basin 72	1.48	0.064	4.32
Basin 28	0.91	0.040	4.40	Basin 73	2.08	0.016	0.77
Basin 29	9.12	0.035	0.40	Basin 74	1.62	0.006	0.35
Basin 30	1.65	0.109	6.60	Basin 75	2.63	0.100	3.80
Basin 31	4.37	0.040	0.90	Basin 76	0.40	0.006	1.56
Basin 32	1.49	0.017	1.20	Basin 77	2.21	0.005	0.23
Basin 33	0.56	0.005	0.87	Basin 78	0.58	0.003	0.47
Basin 34	0.87	0.033	3.84	Basin 79	0.69	0.040	5.74
Basin 35	0.76	0.036	4.70	Basin 80	1.32	0.025	1.91
Basin 36	0.44	0.028	6.35	*Major Costa Rican basins along San Juan River*			
Basin 37	1.71	0.063	3.70	Frío	1 746	0.00	0.00
Basin 38	1.14	0.039	3.45	Pocosol	1 224	0.93	0.08
Basin 39	1.07	0.031	2.92	Infiernito	609	1.99	0.33
Basin 40	0.71	0.041	5.72	San Carlos	2 644	0.34	0.01
Basin 41	1.88	0.051	2.73	Cureña	343	0.76	0.22
Basin 42	0.97	0.020	2.03	Sarapiquí	2 743	0.06	0.00
Basin 43	0.51	0.034	6.63	Chirripó	255	0.41	0.16
Basin 44	1.15	0.009	0.77	*All Costa Rican basins draining to Rio San Juan*			
Basin 45	0.40	0.003	0.74	**Totals**	**9564**	**4.50**	**0.05**

7.3. The areas of impermeable surface introduced by construction of the Road listed in Table 7 were measured from the digital polygons used to represent Route 1856 in the GIS used by Astorga and Mende to create the land use change maps included in the *Land Use Change Report*. These areas include not only the road bed itself, but also the entire right-of-way and, bearing in mind that the surface of the road bed is either bare soil or crushed rock – neither of which are entirely impermeable, these areas are highly conservative, upper-bound values.

7.4. The results listed in Table 8 reveal that in 65 of the 80 micro-basins, the Road increases the impermeable area by less than 5% of the total drainage area, while in more than half the micro-basins the increase is less than 2.5%. The impermeable area of the Road comprises more than 10% of the drainage area in just four micro-basins, with the highest single figure being 14%.

7.5. These findings establish with a high degree of confidence that the possibility of local impacts due to reductions in the catchment permeability following construction of the Road is limited to four of the smallest micro-basins, which have drainage areas of about 1 km^2 or less. With respect to the main stream Río San Juan itself, it is inconceivable that an increase of 0.05% in the impermeable area within the tributary basins draining to the River from Costa Rica could have any discernible hydrological impact, let alone cause any damage whatsoever to the river, its environment or its ecosystem.

C. Hydrologic modelling Costa Rican micro-basins draining to the Rio San Juan between Marker II and the Delta with and without Route 1856

7.6. The HEC-HMS hydrological model developed by the US Army Corps of Engineers was used to simulate the hydrology of each micro-basin prior to and following construction of Route-1856. This model is designed to simulate rainfall-runoff processes in a wide range of geographic areas, for solving a wide range of problems (http://www.hec.usace.army.mil/software/hec-hms/). The 38-year record of daily precipitation measured at the nearby El Bum hydrometric Station (station 69-578) between 1976 and 2013 provided the rainfall input to the model.

7.7. Appropriate Soil Conservation Service (***SCS***) Curve Numbers were used to represent infiltration in each micro-basin prior to and following construction of Route 1856, based on the land use change maps provided by Astorga and Mende in their 2013 Report and the increases in impermeable areas listed in Table 7. SCS Curve numbers are routinely used by the Natural Resources Conservation Service (***NRCS***) of the US Department of Agriculture to simulate increases in impermeable areas in urbanizing catchments
(https://engineering.purdue.edu/mapserve/sedspec/doc/tr55.pdf).

7.8. Antecedent moisture condition II, corresponding to average conditions, was selected to represent moisture levels at the beginning of each simulation. For each micro-basin initial abstractions (Ia) and time of concentration (tc) were calculated based on Curve Numbers representative of pre- and post-Route 1856 conditions and appropriate morphometric parameters for each micro-basin (drainage area, average slope, length of the longest flow path, etc.). The lag time (tg) was assumed to be 60% of the time to concentration, as indicated by the SCS Lag Time equation. The results are listed in Table 8 and shown in Figure 24.

Table 8. Average monthly stream flows from micro-basins draining to the Río San Juan, predicted using a HEC-HMS model simulation from 1976 to 2013 for conditions with and without Route 1856 (from the 2013 ICE Report).

Month	Runoff without Road (m^3 s^{-1})		Runoff with Road (m^3 s^{-1})		Difference (m^3 s^{-1})
	Mean	Error margin	Mean value	Error margin	
January	16.46	1.13	16.47	1.42	3.81×10^{-3}
February	11.63	0.81	11.63	1.20	6.39×10^{-4}
March	8.06	0.64	8.06	1.01	1.45×10^{-4}
April	8.87	0.76	8.87	1.16	1.03×10^{-4}
May	13.70	0.86	13.70	1.01	1.38×10^{-4}
June	20.46	1.23	20.46	1.43	1.37×10^{-4}
July	25.84	1.31	25.84	1.59	1.69×10^{-4}
August	20.05	1.10	20.05	1.33	5.51×10^{-5}
September	15.04	0.90	15.04	1.35	3.76×10^{-5}
October	17.05	1.02	17.05	1.20	2.72×10^{-5}
November	24.45	1.32	24.45	1.46	2.76×10^{-5}
December	23.09	1.35	23.09	1.54	1.50×10^{-5}

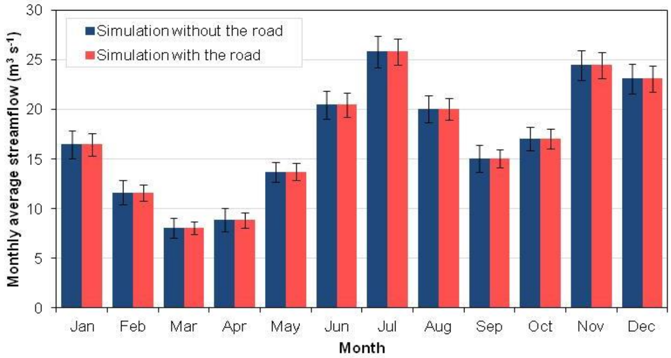

Figure 24. Mean monthly discharges from micro-basins draining to the Río San Juan with and without Route 1856. Bars indicate error margins (from 2013 ICE Report).

7.9. The first point to note in Table 8 and Figure 24 is that monthly average discharges from all the micro-basins combined are very small compared to the annual average discharge in the Río San Juan (which is 442 $m^3\ s^{-1}$ at El Castillo (Station 01-02), which is located near Marker II, rising to 1 123 $m^3\ s^{-1}$ at La Trinidad (Station 01-03): see monthly distribution of flow at La Trinidad in Figure 20 and Map in Figure 16 above). Consequently, even substantial changes in discharges input to the Río San Juan from the micro-basins would have little or no impact on the far larger flows in the main stream. However, the Road's impacts on monthly average discharges from the micro-basins are actually miniscule: they are visually undetectable in Figure 24 and fall well within the error margins for the expected discharges listed in Table 8 and shown as error bars in Figure 24.

D. Discharges from all Costa Rican basins draining to the Rio San Juan between Marker II and the Delta with and without Route 1856

7.10. Although discharges to the Río San Juan from the micro-basins are very small compared to those in the main stream River, the same cannot be said for the seven major Costa Rican tributaries. However, in the catchment contexts of the main tributary basins, the increases in impermeable areas due to construction are even smaller than those in the micro-basins. The findings listed in Table 8 reveal that the Road has not increased the impermeable area in any of the major tributary basin by more than a third of one per cent while, when all Costa Rican basins are considered together, the overall increase in impermeable area draining to the Río San Juan amounts to a miniscule 0.05%.

7.11. To examine the possible hydrological impacts of the Road in the context of runoff from the Costa Rican basins as a whole, it was necessary to synthesise the pre- and post-Route 1856 discharge regimes for all the basins (main and micro) as a whole.

7.12. Derivation of the mean annual discharges input to the Río San Juan from the seven major tributary basins prior to construction of the Road is described in Sections 6.D(2) and 6.D(3) and the results are indicated in Figure 17. These much larger basins incorporate the eighty micro-basins mapped in Figure 23.

7.13. The next stage was to break the average annual discharges down into average monthly discharges using the Area-Precipitation method and the discharge balance presented in Section 6.D(3). In these calculations, the records used to represent the main tributary basins came from 1971 to 2006 (which is prior to construction of the Road) for the three gauged basins: Frío (Guatuso Station 16-02), San Carlos (Terrón Colorado Station 14-04), and Sarapiquí (Puerto Viejo Station 12-03 and Veracruz Station 12-04).

7.14. At the larger scales of these major basins, increases in impermeable area due to construction of Route 1856 were all less than one third of 1% (see Table 8), which is too small for there to exist even the possibility of a measurable impact average monthly discharges. Consequently, hydrological analysis of the seven major tributaries was not repeated for conditions with the Road. Instead, monthly average discharges to the Rio San Juan under post-Route 1856 conditions were calculated by adding the absolute differences in discharges modeled for the micro-basins (as listed in Table 8) to the average monthly values calculated for the pre-Road period, 1971 to 2006. The results are listed below in Table 9 and illustrated in Figure 25.

Table 9. Monthly average stream flows for all basins (micro and macro) draining to the Río San Juan. Time series generated from 1971 to 2006 for Pre- and Post-Route 1956 conditions (from 2013 ICE Report).

Month	Stream flow ($m^3 s^{-1}$)			Absolute difference (m^3s^{-1})	Relative difference (%)
	Pre-Route	Post-Route	Error margin		
January	765.30	765.44	103.7	3.81×10^{-3}	4.97×10^{-4}
February	535.56	535.59	54.8	6.39×10^{-4}	1.19×10^{-4}
March	400.64	400.64	34.9	1.45×10^{-4}	3.62×10^{-5}
April	360.78	360.79	40.2	1.03×10^{-4}	2.86×10^{-5}
May	561.09	561.09	76.8	1.38×10^{-4}	2.45×10^{-5}
June	781.79	781.80	59.2	1.37×10^{-4}	1.75×10^{-5}
July	1000.46	1000.47	60.5	1.69×10^{-4}	1.69×10^{-5}
August	1001.94	1001.94	53.0	5.51×10^{-5}	5.50×10^{-6}
September	894.23	894.23	35.9	3.76×10^{-5}	4.21×10^{-6}
October	974.93	974.93	54.3	2.72×10^{-5}	2.79×10^{-6}
November	1069.41	1069.41	100.4	2.76×10^{-5}	2.58×10^{-6}
December	1043.77	1043.78	118.6	1.50×10^{-5}	1.44×10^{-6}

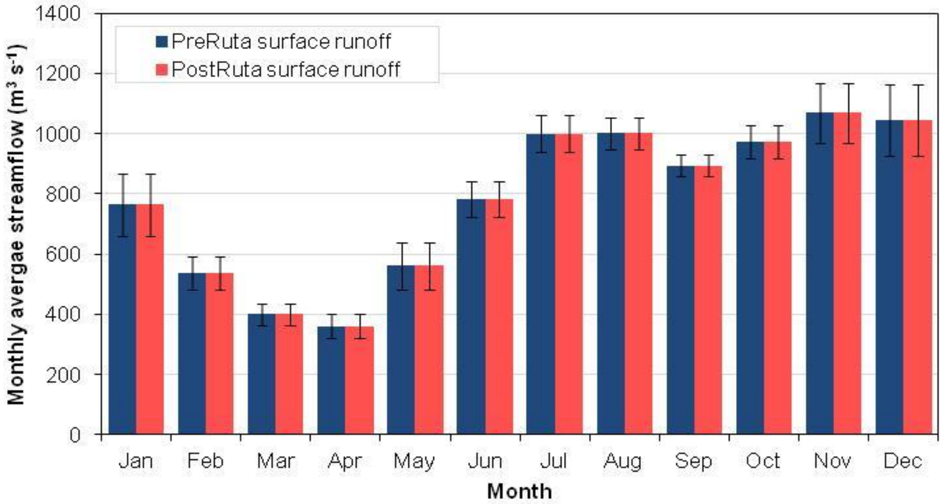

Figure 25. Monthly average stream flows for all Costa Rican tributary basins (micro and macro) draining to the Río San Juan under Pre- and Post-Route 1956 conditions. Times series generated from 1971 to 2006. Bars indicate error margins (from 2013 ICE Report).

7.15. In the context of the far larger catchments of the seven main Costa Rican tributaries, which drain a combined area of 9 198 km^2, the Road's impacts on monthly average discharges are minute, being visually undetectable in Figure 25 and entirely negligible compared to the error margins for the expected discharges listed in Table 9 and shown as error bars in Figure 25. The drainage area of the Río San Juan in the vicinity of the Road increases from 32 819 km^2 at El Castillo (Station 01-02) to 38 730 km^2 at La Trinidad (Station 01-03), making it 3 to 4 times larger than that of the Costa Rican tributary basins combined. In this context, the hydrological impact of the Road must be infinitesimal and, most certainly, scientifically undetectable.

E. Conclusions

7.16. The results of spatial analyses using GIS, runoff simulations using well established hydrologic models, and discharge calculations based on the records of long established rainfall and discharge measuring stations demonstrate unequivocally that construction of Route 1856 could not possibly be responsible for any discernible differences in discharges supplied to the Río San Juan from seven large basins and 80 micro-basins draining to the River from Costa Rica.

7.17. The drainage area of the basin of the Río San Juan at La Trinidad (Station 01-03) is 38 730 km^2 – which is around four times that of the Costa Rican tributary basins combined (9 709 km^2). Hence, the already tiny impacts of the Road on the hydrology of the Costa Rican basins will be further diminished in the context of the far larger drainage area of the basin of the Río San Juan. The inescapable conclusion must be that there is no possibility that the Road has had, will have, or indeed could ever have any measurable impact on the hydrology of the Río San Juan.

8. Has sediment from Route 1856 had any significant impact on the Río San Juan?

A. Introduction

8.1. This chapter reports the results of analyses performed to ascertain whether sediment eroded from road bed, cut slopes, fill slopes and other areas disturbed by construction of Route 1856 has had significant impacts on the Río San Juan. This was addressed through analysis of existing records of recent and historical suspended sediment concentrations (reported in the 2013 ICE Report), application of land use change maps provided by Astorga and Mende (the *Land Use Change Report*), uptake of the inventory of slopes and water courses, field and remote sensing provided in the 2013 *Inventory of Slopes and Water Courses* Report by Mende and Astorga, and the results of field monitoring of rates of erosion and land surface lowering delivered in the 2013 UCR Report.

B. Has the Road significantly impacted suspended sediment concentrations or loads in the Río San Juan?

8.2. The aim of this part of the sediment study was to examine measured suspended sediment concentrations in the Río San Juan in order to ascertain whether erosion and sediment delivery from the Road has significantly increased the sediment load of the River. To do this I examined the available records of measured Suspended Sediment Concentration (***SSC***) prior to and following construction of the Road. As no historical records of bed load exist, it was not possible to extend this analysis of existing, measured data to the coarse fraction of the sediment load.

8.3. As noted in Section 6.E above, SSC records from Station 01-03 at La Trinidad between January 1974 and March 1976, and Station 11-04 at Delta Colorado, between December 2010 and June 2013 are suitable for this purpose as they represent periods before and after construction of the Road. SSCs measured at these two stations should be comparable because over 90% of the flow and sediment that passes through the La Trinidad also passes through the Delta

Colorado Station. Station locations are mapped above in Figure 16 and their records are listed in Table 10, below (which is extracted from Table 4).

Table 10. Suspended sediment records for the Río San Juan – Colorado (data taken from Table 4 above).

Station code	Name	River	No. of samples	Sampling period	Average Annual Suspended load (t yr^{-1})
01-03	La Trinidad	San Juan	12	1974-1976	7 995 000
11-04	Delta Colorado	Colorado	31	2010-2013	5 981 000[a]

[a]Note: this is the average annual suspended load in the Río Colorado.

8.4. For comparison, the recorded data are plotted together on a single graph, with rating curves for SSC as a function of discharge for each station and period added using regression in Figure 26.

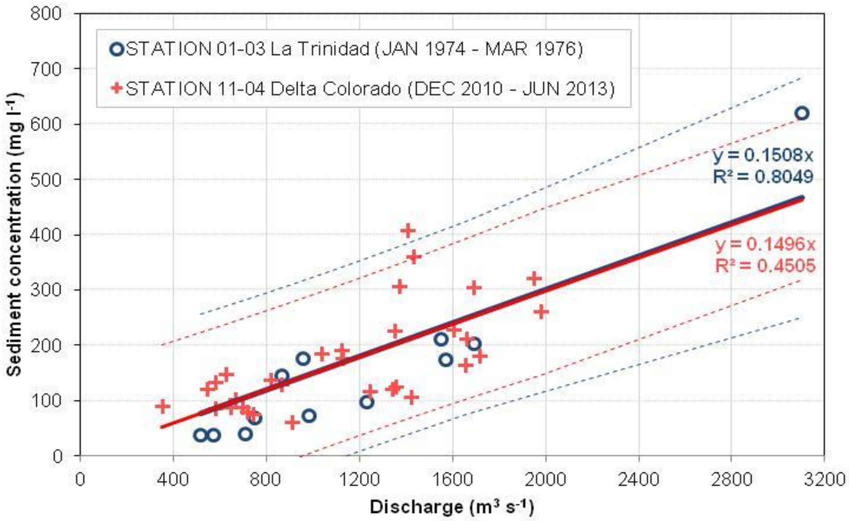

Figure 26. Measured suspended sediment concentrations, rating curves and 95% confidence intervals for pre-Road [La Trinidad (01-03), January 1974 to March 1976] and post-Road [Delta Colorado (11-04), December 2010 to June 2013] periods. Continuous lines are SSC Rating Curves (based on best-fit regression). Dotted lines indicate the 95% confidence intervals (from the 2013 ICE Report).

8.5. If additional sediment from the Road had caused an increase in the rate of sediment transport in the Río San Juan, this would reflect in Figure 26 through increases in the SSCs measured since 2010 and a corresponding upward shift in the 2010-2013 suspended sediment rating curve compared to that for 1974-1976.

It is clear from Figure 26 that this is not the case. On the contrary, the highest measured concentration (SSC > 600 mg l^{-1}) was actually observed during the period *before* construction of the Road and the distribution of 27 of the 31 post-Road measured concentrations in Figure 24 coincides with that of the pre-Road data. Not only is there no statistically significant difference between the pre- and post-Road suspended sediment rating curves, but Figure 26 reveals them to be practically identical. This suggests that any differences between pre- and post-Road SSCs measured at these stations are the result of random chance.

8.6. Additionally, the high degree of natural variability in the relationship between discharge and SSC means that the 95% confidence intervals on the rating curves are wide apart. Not only is natural variability similar during the pre- and post-road periods, but the two uncertainty bands are also close to coinciding. This illustrates that variability in measured SSCs has not changed significantly between pre- and post-Road periods and that differences between measured values are probably due to random chance.

8.7. Based on these two findings, the answer to the question of whether construction of the Road has increased sediment concentrations in the Río San Juan is an emphatic No.

8.8. As discharge is measured on a semi-continuous basis at both these hydrometric stations, the suspended sediment rating curve can be integrated with the discharge record to calculate the mean annual Suspended Sediment Load (***SSL***). This approach was used to calculate the mean annual SSL's transported by the Río San Juan at La Trinidad between 1974 and 1976 and by the Río Colorado at Delta Colorado between 2010 and 2013, which are around 7 995 000 and 5 981 000 t y^{-1}, respectively (as listed in Table 10).

8.9. The average discharges measured at the La Trinidad and Delta Colorado stations listed in Table 4 are 1 123 m^3 s^{-1} and 1 026 m^3 s^{-1}, respectively. This suggests that, on average, roughly 90% of the discharge in the Río San Juan approaching Delta Costa Rica passes to the Río Colorado, while roughly 10% passes to the lower Río San Juan. As the suspended load is distributed throughout the River's flow, it is reasonable to assume that the SSL is similarly divided.

8.10. On this basis the SSL measured in the Río Colorado at the Delta Colorado station may be adjusted to represent that in the Río San Juan upstream of the Delta by multiplying it by the reciprocal of 0.91. Applying this adjustment, the average annual SSL in the Río San Juan between December 2010 and June 2013 was approximately 6 573 000 t y^{-1}. It follows that the mean annual SSL in the lower Río San Juan during this period was about 592 000 t y^{-1}.

8.11. In considering these figures, it must be borne in mind that they are based on small numbers of samples made over short (two to three-year) periods of observation. The 95% confidence intervals of the regression relationships used to generate the suspended sediment rating curves reflect not only uncertainty due to the small number of data points, but also the high degree natural variability inherent to the way that SSCs vary with discharge in the Río San Juan. Recognising this, uncertainty analyses were performed on the data for both stations to produce 95% confidence intervals for the calculated mean annual SSL's in the Río San Juan. The results are illustrated below in Figure 27 and listed in Table 11.

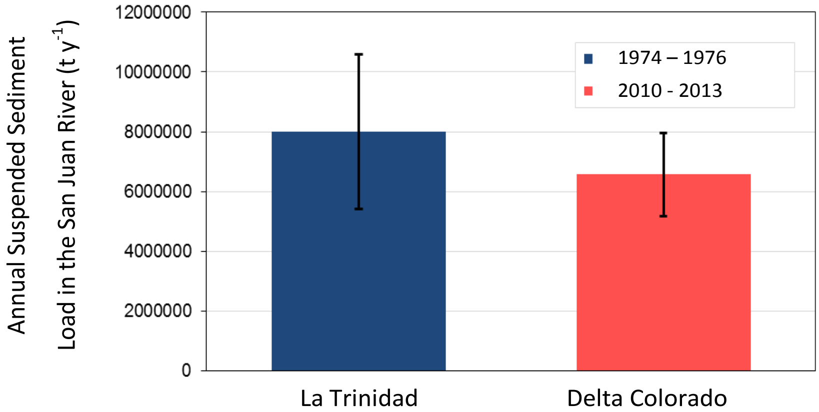

Figure 27. Mean annual suspended sediment loads in the Río San Juan based on measurements at La Trinidad (1974-1976) and Delta Colorado (2010-2013). Vertical bars indicate 95% confidence intervals. Note that the loads based on measurements at Delta Colorado station have been adjusted to represent the Río San Juan on the basis that at the Delta suspended load is divided in the same proportion as discharge (from the ICE Report).

Table 11. Mean annual suspended sediment loads in the Río San Juan – Colorado (from the ICE Report)

River	Period	Mean Annual Suspended Sediment Load (t yr^{-1})	
		Best Estimate	**95% Confidence Interval**
San Juan	1974 - 1976	7 995 000	5 405 000 - 10 585 000
San Juan	2010 - 2013	6 573 000	5 181 000 - 7 966 000
Colorado	2010 - 2013	5 981 000	--
lower San Juan	2010 - 2013	592 000	--

8.12. In comparing the suspended sediment loads transported annually by the River during the two periods of observation, the first point to note is that the best estimate of the mean for 2010-2013 is noticeably *lower* than that for 1974-1976. This is unsurprising, because the post-Road period has been drier than usual. For example, measured data for the hydrometric El Bum station (69-578) indicate that mean annual rainfall in the hydrological year 1975-1976 was 3 651 mm, compared to only 2 267 mm in the hydrological year 2011-2012. Lower rainfall produces less catchment runoff that generates less erosion and, therefore, a smaller SSL.

8.13. This result demonstrates that construction of the Road has not led to a significant increase in the SSL carried by the Río San Juan.

8.14. However, it is instructive to consider that the difference between the mean annual suspended loads falls within the confidence intervals on those means (listed in Table 11). As the over-lapping 95% confidence intervals in Figure 27 confirm, the high levels of measurement uncertainty and natural variability in annual SSL's mean that there is no statistically significant difference between mean annual SSL's for periods prior to and following construction of the Road.

8.15. The point is that, notwithstanding the difference in calculated SSL's, analysis of the measured data indicates that they are not *significantly* different. Statistically, there is a 95% probability that the two sample means come from the same population of annual SSL's, a population that is characterised by a very high degree of inter-annual variability. It must, therefore, be concluded that the difference between them is statistically insignificant.

8.16. These data reveal that measurement uncertainty, together with natural fluctuations in rainfall, discharges, catchment sediment yields and SSC's, mean that SSL's are likely to vary inter-annually between about 5 and 10.5 million tonnes. Using longer measurement records with more measurements might reduce the confidence interval on the mean annual SSL somewhat, but the range of expected values would remain wide because high natural variability is a property characteristic of the River, not the data.

8.17. The significance of this finding is that it while it shows that the Road has had no significant impact on SSL in the River, it also demonstrates that no possibility exists for using measured loads to estimate how much sediment derived from erosion of the Road has been added to the Río San Juan, due to the very high natural variability in those loads.

C. Is the 1 m y^{-1} rate of land lowering used in the 2012 Kondolf Report reasonable?

8.18. In the 2012 Kondolf Report, Dr Kondolf estimates on page 46 that,

> "landslide/gully erosion averages 1 m deep (i.e., lowering of the land surface by 1 m on average".

8.19. This estimate is not based on monitoring or measurement, but on visual observation of the Road from the air and the River in October 2012. On the same page of the 2012 Report, Dr Kondolf estimates the proportion of eroded soil that is input to the Río San Juan is 40%[9].

8.20. Using these estimates for erosion and sediment delivery ratio, Dr Kondolf estimates that the annual input of sediment from the Road to the River is in the range of 87 000 to 109 000 m^3 y^{-1} (2012 Kondolf Report, page 46). This estimate is repeated in his Third Report (on page 2). It is an estimate for *all* sediment delivered from slopes and other disturbed areas along the Road to the River, whether by mass wasting or gullying. In the 2012 Kondolf Report erosion of the

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9 2012 Kondolf Report, pp. 45-46, para. 4.12.

road bed itself is dismissed as being less than 10% of that from slopes and in his Second Report Dr Kondolf notes that most of the road bed has now been covered in gravel, which will further reduce erosion of the road itself, especially in relation to that from cut and fill slopes.

8.21. To establish whether the rate at which the land surface is being lowered by erosion of cut slopes, fill slopes and other disturbed areas along the Road adopted in the 2012 Kondolf Report (1 m y^{-1}) is conservative, or reasonable, a team from the University of Costa Rica has, since 8 June 2013, been monitoring erosion at nine of the most active sites for sheet erosion, rill (micro-channel) erosion, landslides and gullying in a study reach location in the steepest stretch of Road, which is between Marker II and the Río Infiernito (Figure 28). Their results are reported in the 2013 UCR Report.

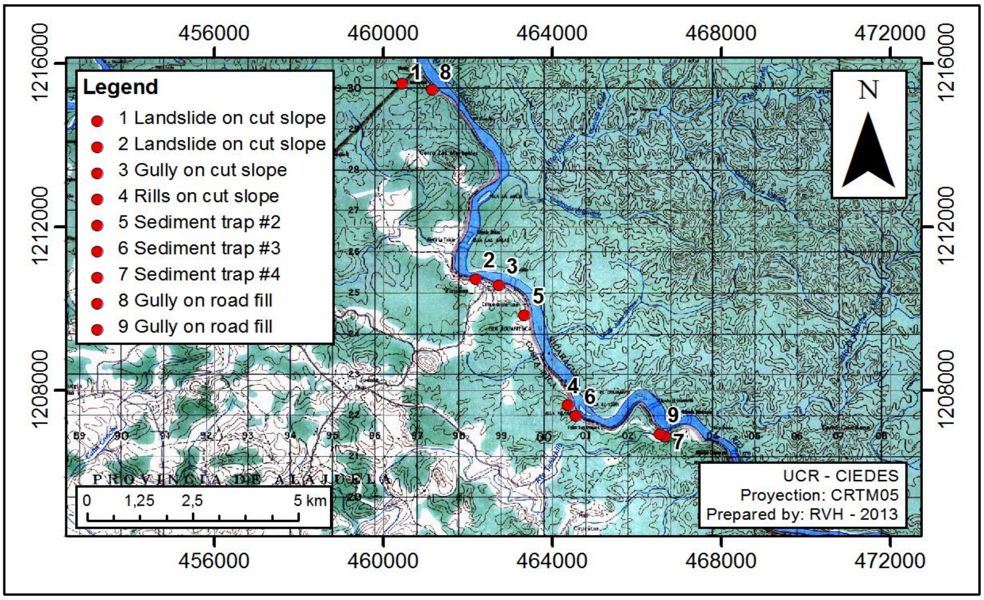

Figure 28. Location of monitored sites (from the UCR Report).

8.22. The monitoring results reported in the 2013 UCR Report and used here come from the two largest rotational landslides observed along the Road in the study area; the three large gullies; the slope which displayed most intense rill (micro-channel) erosion; and a sediment trap that collects sediment eroded from a steep stretch of road bed and cut slope which only experiences sheet erosion (Figures 29 and 30).

(a)

(b)

Figure 29. Sediment trap #2 on (a) 8 June and (b) 22 July 2013 (from the UCR Report).

Figure 30. Rill erosion monitoring site on a cut slope, with rills numbered and 1 metre grid overlaid for scale (from the UCR Report).

8.23. In the Fourth Kondolf Report, Dr Kondolf asserts that the sites monitored by UCR "excluded the most seriously eroding sites".[10] Having viewed the entire length of the Road, I consider that the sites which were monitored by UCR were representative of the characteristics of the geology and terrain in the first 41.6 km of the Road downstream from Marker II, and on that basis the erosion they monitored provides a representative indication of the erosion likely to have occurred along the entire length of that stretch of the Road. I also consider that the sites monitored by UCR were in a section of the Road with the greatest number of landslides and gullies. For these reasons, the results of UCR's monitoring can be taken to be *representative* of erosion along the first 41.6 km of the Road alongside the River, which is the only part of the Road about which Dr Kondolf is concerned.

8.24. Erosion and mass wasting rates along the other 66.4 km of the Road that parallels the Río San Juan downstream of Boca San Carlos are certainly much lower than they are in the area studied by UCR between Marker II and the Río Infiernito, for the reasons set out above in Section 5.A. This finding is confirmed by the results presented by Mende and Astorga (2013) in the *Inventory of Slopes and Water Courses* Report. It is therefore reasonable to assume first, that the recorded rates of land surface lowering approach 'worst case' scenarios for Road-related erosion to date and, second, that their application in calculating erosion and mass wasting along the entire 108 km length of the Road where it parallels the River between Marker II and Delta Costa Rica is highly conservative.

8.25. Based on field measurements, the rate of land surface lowering due to sheet erosion of the road bed and cut slopes varies between about 0.061 m $y^{-1}$and 0.095 m y^{-1}. The range in the rates is due to differences in the amount of soil lost between re-surveys of features made during relatively dry (June - July) and relatively wet (July - August) periods in 2013. Based on these direct measurements it is concluded that using 0.095 m y^{-1} as the basis for estimating

[10] Fourth Kondolf Report, p. 3. See also p. 9.

the average annual rate of lowering of the land surface due to sheet erosion along the entire length of the Road is conservative.

8.26. On those monitored cut slopes where landslides were observed, they occupied 10% to 13% of the overall area of the slope and had lowered the land surface in those areas by between 0.11 and 0.38 metres. These slopes were created when the Road was under construction in 2011 and they have therefore existed for at least two years. This implies average rates of lowering of the land surface due to landslides of between 0.06 and 0.19 m y^{-1} when averaged over the entire areas of the slopes affected.

8.27. Gullies on cut slopes were the rarest erosion feature observed by UCR along the Road between Marker II and the Río Infiernito, while rills were the most common. The worst gully monitored in the study had a maximum depth of 3 metres and a surface area of 13.1 m^2, meaning it covered only just over 2% of the slope in which it had formed. The total volume of soil eroded to create this gully was approximately 6 m^3. When this volume is divided by the total area of the slope, the average lowering of the land surface due to erosion by this gully is 0.01 m. If it is again assumed that the slope was created when the Road was under construction in 2011, this implies a rate of lowering of the land surface due to gullying is 0.005 m y^{-1}, when averaged over the entire area of the slope affected.

8.28. The majority of slopes along the Road between Marker II and the Río Infiernito were observed to experience rill (micro-channel) erosion. At the rill study site, there were 26 rills, the largest of which had a maximum width of 0.3 metres and a maximum depth of 0.6 metres. Based on spatial analysis of all the rills in the sample area, and with the conservative assumption that they *all* had widths and depths equal to that of the largest rill, UCR concluded that rill erosion has lowered the land surface of the slope by an average of 0.12 metres since the Road was constructed, which implies an average rate of lowering of the land surface due to rilling of around 0.06 m y^{-1} when averaged over the entire area of the slope.

8.29. Fill slopes in the studied area do not feature erosion due to deep landslides, with mass wasting limited to much less damaging shallow slips and soil falls. Rill erosion was observed on fill slopes with intensities broadly similar to those observed on cut slopes. Consequently, the rate monitored on the most intensively rilled cut slope (0.06 m y^{-1}) may be conservatively used also to represent rill erosion of fill slopes.

8.30. Gully erosion on fill slopes was observed by UCR to cover about 4% to 10% of the monitored fills, lowering the surface of these slopes by between 0.06 and 0.10 m when averaged over the area of fill slope affected. In contrast to erosion of road cuts, the monitored gullies had formed in about the last six months. Therefore, the estimated average annual rate of land surface lowering due to gully erosion of fill slopes is higher than that for cut slopes, being between 0.12 and 0.20 m y^{-1}.

8.31. Table 12 below summarises the observed average erosion depths and average annual rates of land surface lowering reported above. As this summary lists the highest values of eroded area/area of feature, average eroded depth, and average annual rates of land surface lowering for each erosion type, the data listed are likely to over-estimate actual average values for the Road between Marker II and the Delta and, in this respect, they are conservative.

Table 12. Summary of erosion monitoring results (from the 2013 UCR Report).

Type of feature	Erosion type	Eroded Area/Area of Feature (%)	Average erosion depth (m)	Average rate of land surface lowering (m y^{-1})
Cut Slope	Landslide	13	0.38	0.19
Cut Slope	Gully	2	0.01	0.005
Cut Slope*	Rill	50	0.12	0.06
Road bed and Cut Slope	Sheet	100	0.02	0.095
Fill Slope	Gully	9	0.10	0.20

*these findings may also be conservatively applied to rills on fill slopes.

8.32. In the 2013 UCR Report, the authors recommend using average erosion <u>depths</u> for landslides, gullies and rills on cut slopes in place of estimated annual <u>rates</u> of erosion when calculating average annual rates of land surface lowering along the Road. Doing so is even more conservative because the erosion depths probably represent the amount of land surface lowering over two years, rather than annually. For sheet erosion, the maximum rate observed (i.e. 0.095 m y^{-1} during the wet season) is recommended. Finally, 0.20 m y^{-1} is the most conservative value for gullies in road fills and UCR suggests that this should be used. These rates should all over-estimate actual average erosion rates to date, but considering that the last two years have been drier than average, they could be exceeded in future. This will only be the case if erosion risks are unmitigated, leaving the slopes exposed to potentially heavier rainfall. However, as I observed in May 2013 (discussed below in Chapter 12) and as reported in the 2013 Reports by CONAVI and Codeforsa, work to mitigate erosion risks has begun and I understand that it is projected to continue.

8.33. In the 2012 Kondolf Report, rates of land surface lowering due to erosion were estimated using visual observations of the Road made at a distance from the air and from a boat during a single, two-day visit to the area in October 2012, together with consideration of published studies of sediment budgets in the Pacific Northwest of North America and the team's observations of road-related erosional impacts elsewhere (2012 Kondolf Report, page 46). In his 2012 Report, Dr Kondolf states that,

> "we conservatively estimated that that landslide and gully erosion is occurring on 40-50% of the steep disturbed land (21.8 to 27.3 ha) and that this landslide/gully erosion averages 1 m deep (i.e., lowering the land surface by 1 m on average)."

8.34. Monitoring of landslide and gully erosion reported by UCR above suggests that the rate of land surface lowering estimated in the 2012 Kondolf Report is probably too high by a factor of five for the stretch of Road between Marker II and the Río Infiernito. With respect to the 108 km length of the Road where it parallels the Río San Juan, an average annual rate of land lowering of 1 m y^{-1} is definitely much too high, probably by a factor of ten.

8.35. Further, UCR field monitoring indicates that landslides and gullies on average cover around 10 to 15% of the slopes with these features observed between Marker II and the Río Infiernito. Consequently, the estimate that landslides and gullies occupy 40 to 50% of the area of cut and fill slopes along the

Road, which is made in the 2012 Kondolf Report, would also appear to be a significant over-estimate.

8.36. In my experience, including my inspections of the Road in February and May 2013, of land surface lowering due to landslides and gullies averaging 1 m y^{-1} is too high and it is unlikely to be accurate, especially if applied to the entire length of the Road alongside the River. Also, the assumption that landslides and gullies cover 40 to 50% of slopes and other disturbed areas overstates the extent of these features. Conversely, the monitored rates and areas affected as summarised in Table 12 are consistent with my own observations and, in my opinion, are likely to be more representative of conditions encountered in general along the Road.

8.37. Recognising this, the average annual volume of sediment eroded from the Road between Marker II and Boca San Carlos (i.e. the upstream 41.6 km of the Road that runs adjacent to the River) estimated by Dr Kondolf (reported on page 46 of the 2012 Kondolf Report) of 218 400 to 273 000 m^3 y^{-1} is likely to be significantly too high.

8.38. In his Third Report Dr Kondolf emphasizes the impact of 'mass wasting' which he describes as involving,

> "the movement of larger volumes of earth by gravity, often along failure plains determined by differences in material, such as the boundary between a volume of fill material and the existing slope upon which it was placed."

I agree in principle with this description.

8.39. Dr Kondolf also states that, on his inspection in October 2013,

> "[s]ignificant cutslope and fillslope mass wasting as also locally evident".[11]

8.40. However, the 'mass wasting' Dr Kondolf is said to have observed in October 2013 has not caused him to revisit his 2012 estimates of erosion from the

11 Third Kondolf Report, p. 14.

Road, which, as noted in paragraph 8.20 above, already includes all sediment input, whether from mass wasting or gullies.

8.41. All forms of mass wasting (including landslides) are driven by gravity. In short the weight of the slope becomes greater than its strength and it falls down. Failure may be triggered by any of the processes listed as triggering landslides on page 14 of the 2013 UCR Report. Essentially, there is a range of mechanisms by which slopes retreat due to mass wasting, with landslides being the largest in scale and shallow slides being the smallest. In the studies reported in the 2013 Reports by UCR and ICE, which yield the estimates for sediment input described in Table 12 above, all mass wasting is treated as being by landslides. As a result, the estimates for sediment input are conservative, because landslides are the largest in scale of the potential events which result in mass wasting. Furthermore, it is clear that these estimates take account of all potential sediment input from the Road to the River, including by mass wasting.

8.42. To investigate whether sediment eroded from the Road could pose any risk to the Río San Juan, the 2013 ICE Report took up the results reported in the 2013 Reports by UCR and Mende and Astorga (The *Inventory of Slopes and Water Courses* Report) and used them to estimate sediment delivery rates from the Road to the River. The work was performed in two steps. First, the average volume of sediment eroded from the Road, cut slopes, fill slopes and other disturbed areas was estimated. For the road bed the higher of the two rates of erosion reported in the 2013 UCR Report (0.095 m y^{-1}, as listed in Table 12) was accepted. ICE then used the length, area and steepness of the road bed and adjacent disturbed ground within each of the major tributary basins draining to the River between Marker II and Delta Costa Rica to estimate the average annual volume of sediment eroded from the road bed in each tributary basin.

8.43. For cut and fill slopes, ICE accepted the Mende and Astorga's estimates (in the *Inventory of Slopes and Water Courses* Report) for the average annual volumes of erosion by landslides and gullies along the Road in each of the tributary basins, which are based on areas recorded in their 2013 inventory of slopes and application of the erosion depths reported in the 2013 UCR Report (as listed in Table 12).

8.44. The five main river basins draining from Costa Rica to the Río San Juan between Marker II and Delta Costa Rica are mapped below in Figure 31(a), and the eroded volumes compiled by ICE are listed for each basin in Table 13.

Table 13. Estimated average annual erosion rates (from the 2013 ICE Report).

Basin	Road length (km)	Annual rate by volume ($m^3 y^{-1}$)			Annual rate by mass* ($t y^{-1}$)		
		Road	Slopes	Total	Road	Slopes	Total
Major Costa Rican river basins draining directly to the Río San Juan between Marker II and Delta							
Infiernito	38	12 260	28 000	40 260	20 450	46 750	67 250
San Carlos	11	2 060	600	2 660	3 450	1 000	4 450
Cureña	28	5 220	7 560	12 780	8 700	12 650	21 350
Sarapiquí	3	560	160	720	950	250	1 200
Chirripó	22	4 100	260	4 360	6 850	450	7 300
Costa Rican area that drains directly to the San Juan River between Marker II to and Delta Colorado							
Total	102	24 200	36 580	60 780	40 400	61 100	101 550

* To convert eroded volumes to masses, a bulk density of 1.67 t m^{-3} was assumed. This value is widely used to represent the bulk density of silt-sand soils.

8.45. Second, ICE applied a sediment delivery ratio to estimate the proportion of the eroded sediment reaching the Río San Juan. Dr Kondolf estimated this delivery ratio to be 40% (2012 Kondolf Report, page 46). However, considering the small size of many of the micro-basins draining either directly to the Río San Juan or to the five major Costa Rican tributaries, the large number of crossings identified in the *Inventory of Slopes and Water Courses* Report by Mende and Astorga, and bearing in mind the relatively fine grain size of most of the eroded sediment (found to be mostly silt – see Table 5 in the 2013 UCR Report), ICE concluded that Dr Kondolf's estimate was probably low and they instead used a considerably higher estimate of 60%. I concur with ICE's selection of 60% as being reasonable but more conservative than Dr Kondolf's assumption of 40%. The results of applying this higher delivery ratio are listed in Table 14 and shown in Figure 31(b).

Table 14. Average annual inputs of Road-derived sediment to the Río San Juan (from the ICE Report)

Basin	Road length (km)	Input by volume (m^3 yr^{-1})			Input by mass* (t yr^{-1})		
		Road	Slopes	Total	Road	Slopes	Total
Major Costa Rican river basins draining directly to the Río San Juan between Marker II and Delta							
Infiernito	38	7 360	16 800	24 160	12 250	28 050	40 300
San Carlos	11	1 240	360	1 600	2 050	600	2 650
Cureña	28	3 140	4 540	7 680	5 200	7 600	12 800
Sarapiquí	3	340	100	440	550	150	700
Chirripó	22	2 460	160	2 620	4 100	250	4 350
Costa Rican area that drains directly to the Río San Juan between Marker II to and Delta Colorado							
Total	102	14 540	21 960	36 500	24 150	36 650	60 800

* To convert eroded volumes to masses, a bulk density of 1.67 t m^{-3} was assumed. This value is widely used to represent the bulk density of silt-sand soils.

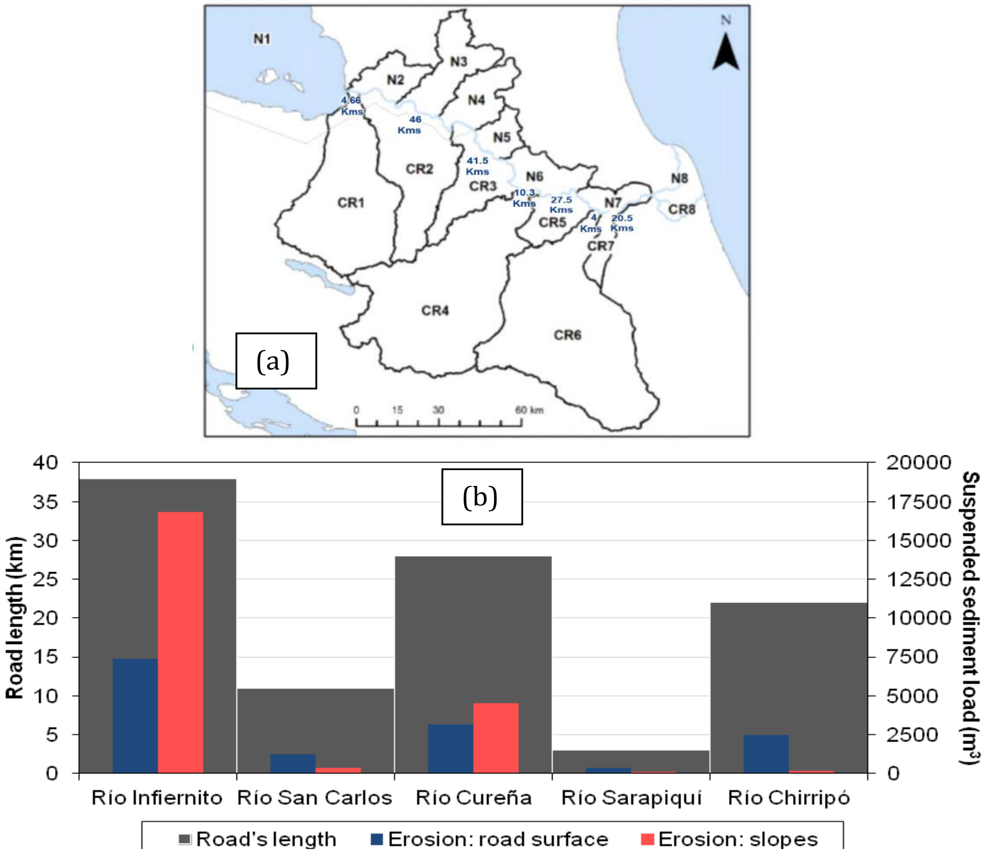

Figure 31. (a) Map showing the major tributary basins between Lake Nicaragua and Delta Costa Rica. (b) Length of Road and estimated annual average inputs of sediment to the Rio San Juan from erosion of the road and cut/fill slopes in basins CR3 (Infiernito) to CR7 (Chirripó) between Marker II and the Delta (from 2013 ICE Report).

8.46. The results plotted in Figure 31 above indicate that delivery of sediment eroded from slopes along the Road in the San Carlos, Sarapiquí and Chirripó reaches of the Río San Juan is negligible. Input of the slope-derived sediment in the Infiernito stretch of the Road is higher, which is consistent with Dr Kondolf's decision to focus his attention on that stretch in the 2012 Kondolf Report, a decision he did not revisit in his Second, Third and Fourth Reports.

8.47. However, the estimated average annual input sediment eroded from the Infiernito reach of the Road is around 24 000 $m^3 y^{-1}$, which is only a third to a quarter of that estimated by Dr Kondolf for the first 41.6 km of the Road between Marker II and Boca San Carlos (87 000 – 109 000 $m^3 y^{-1}$). Indeed, the estimated input for the entire length of the Road alongside the River between Marker II and Delta Costa Rica (36 500 $m^3 y^{-1}$) is only a third to a half of that estimated on page 46 of the 2012 Kondolf Report.

8.48. The average annual rates of additional sediment delivery listed in Table 14 and graphed in Figure 31(b) represent conditions since December 2010 and up to June 2013. These results indicate that during this period additional sediment eroded from the Road was delivered to the Río San Juan in the Infiernito reach and, to a lesser degree, the Cureña reach, but at rates insufficient to have any significant impact on the River or its surrounding environment. Lack of significant impact is due to: (i) the large discharge of the Río San Juan (see Section 6.D, above), (ii) the River's inherent capacity to transport very large and highly variable amounts of sediment (see Section 8.B above), and (iii) its capacity to transport varying sediment loads without perturbing either reach-scale channel morphology, which is geologically-controlled (see Sections 6.B and 6.C above), or in-stream and riparian habitats and ecosystems, which are well adapted to high and variable sediment loads (see Section 10, below and, for details, the 2013 CCT Report).

8.49. In the ICE Report (based on application of detailed field measurements reported in the *UCR Report* and Mende and Astorga *Inventory of Slopes and Water Courses*), construction of the Road is estimated to have added, at most, 36 500 $m^3 y^{-1}$ (60,800 t y^{-1}) of sediment to the load of the Río San Juan. I am confident that this figure is more reliable than the much higher estimate of 87 000 to 109 000 $m^3 y^{-1}$ (145 290 and 182 030 t y^{-1}) made by Dr Kondolf, which is based on observations from a boat and a helicopter made over two days in October 2012 and which was not revisited or revised in his second, third or fourth Reports.

D. Potential for Road-derived sediment to have a significant impact on the Río San Juan

(1) Introduction

8.50. The purpose of this Section is to use the evidence provided in Sections 8.B and 8.C above to examine whether the additional Road-derived sediment supplied to the Río San Juan could damage the River and its environment and whether the additional sediment derived from Road could have caused aggradation in the lower Rio San Juan sufficient to require Nicaragua to dredge the River to maintain navigation and flow in that watercourse. In summary, the evidence does not support either of these propositions.

(2) Estimated annual load of Road-related sediment supplied to the Río San Juan

8.51. According to the estimates made in the 2012 Kondolf Report (on page 46), the average total quantity of sediment supplied to the Río San Juan by the Road annually is 87 000 to 109 000 $m^3 y^{-1}$. As explained in Section 8.C above, this estimate includes all potential sources of sediment along the Road considered significant in the 2012 Kondolf Report (a finding not revisited in Dr Kondolf's Third Report), including gullies and mass wasting.

8.52. It should be noted that Dr Kondolf's figure is derived from observations referenced only to the first 41.6 km of the Road between Marker II and Boca San Carlos. Dr Kondolf made no estimate of erosion from the remaining 66.4 km between Boca San Carlos and Delta Costa Rica. As noted above in paragraph 4.6 according to Dr Kondolf, 42 of the 54 locations where he says that he observed Road-derived sediment to have entered or to be entering the Río San Juan are located within the first 41.6 km, with only 11 along the remaining length of the

Road. On this basis, the upper bound of Dr Kondolf's estimated range seems likely to be close to what he would have estimated for the entire Road.

8.53. As reported in Section 8.C above, ICE's estimate for the total quantity of Road-derived sediment delivered to the River is 36 500 $m^3 y^{-1}$, which is only a third of the upper bound of the range estimated by Dr Kondolf. For the reasons stated earlier, my view is that Dr Kondolf's use of 1 m y^{-1} as the average rate of lowering of the land surface due to landsliding and gullying between Marker II and Boca San Carlos is almost certainly an over-estimate. My observations along the entire length of the Road likewise indicate to me that Dr Kondolf's estimate is far too high to be representative of erosion along the 66.4 km stretch between Boca San Carlos and Delta Costa Rica. Likewise, I believe that his assumption that 40 to 50% of slopes are covered by landslides and gullies is also an over-estimate.

8.54. Notwithstanding this, in examining whether the input of Road-derived sediment could significantly impact the Río San Juan or impede navigation in the *lower Río San Juan* to the degree necessary to require dredging, in my November 2013 Report submitted to the Court in response to Nicaragua's request for the indication of provisional measures in the *Construction of a Road Case*, I was instructed to proceed on the basis of Dr Kondolf's estimate of average annual sediment delivery of road-derived sediment. This exercise did not imply acceptance of Dr Kondolf's estimate, which, for the reasons I have explained, I consider to be a significant over-estimate. In the comparison below I revert to the more reliable estimates made by ICE in their 2013 Report, based on the field monitoring carried out by Costa Rica's technical teams.

(3) Comparison of the additional Road-derived sediment to the average annual sediment load in the lower Río San Juan since December 2010

8.55. Sediment loads in the River are expressed by mass (tonnes) rather than volume (cubic metres). As noted in Tables 13 and 14 above, a cubic metre of sediment has a mass of about 1.67 tonnes. This is typical for closely-packed, quartz sand grains, though it may be a little high for soil (which has a higher porosity). Hence, it is conservative. Assuming that each cubic metre of soil has a mass of 1.67 tonnes, the average annual load of Road-related sediment input to the Río San Juan is (as listed above in Table 14, based on field monitoring), 60 800 t y^{-1}.

8.56. As explained in Section 6.E and listed in Table 6 above, the average annual total sediment load (that is suspended load plus bed load) carried by the Río San Juan between December 2010 and June 2013 was around 9 133 000 t y^{-1}, of which around 8 470 000 t y^{-1} passes to the Río Colorado and 663 000 t y^{-1} to the lower Río San Juan.

(4) Relative input of Road-derived sediment to the Río San Juan

8.57. If 60 800 t y^{-1} enters the Río San Juan this would make up less than 1% of the total sediment load carried by the Río San Juan, which is 9 133 000 t y^{-1}. This is obviously too small a proportion to have any significant impacts on the River. As noted in paragraph 8.49 above, Dr Kondolf's estimate of a range of sediment delivered annually from the Road to the River (145 290 and 182 030 t y^{-1}) is significantly overstated. But even if it were an accurate assessment, which Costa Rica does not accept, it would represent only 1.6% to 2% of the total annual sediment load of the Río San Juan. A contribution of sediment in this range would still be far too small to have any adverse impact on the River.

8.58. Assuming that 10% of the additional sediment from the Road enters the lower Río San Juan, this suggests that the average annual input of Road-derived sediment to the lower Río San Juan is 6 080 t y^{-1}, which constitutes less than 1% of the 663 000 t y^{-1} total load in the lower Río San Juan downstream of the Delta.

8.59. The lower Río San Juan is approximately 30 km long and it has an average channel width around 90 m, giving it a bed area of about 2.7 million m^2. The 6 080 t y^{-1} input of Road-derived sediment is equivalent to 3 650 m^3 y^{-1} in volumetric terms. Supposing that <u>all</u> of this Road-related sediment were deposited on the bed of the lower Río San Juan (with none at all deposited on the floodplains and in the wetlands or passing through to the Caribbean Sea), the average increase in the rate of aggradation of the bed would be less than 0.2 mm y^{-1}.

8.60. Even this tiny increase in sedimentation is actually an over-estimate. As illustrated in Figure 19 above, the Río San Juan is a sand bed river. Consequently, in practice it is likely that only the sand fraction of the additional sediment derived from erosion of the Road would be deposited on the bed of the River. On page 44 of his 2012 Report, Dr Kondolf notes that,

> "The cones of sand and gravel we sampled probably represent less than 5% of the total amount of sediment that passed at those points into the river."

The particle size analyses performed UCR and reported in their 2013 Report, support this conclusion: on average, sand made up less than 10% of the Road-derived sediment they sampled. It follows that probably only 5 to 10% of the additional sediment derived from the Road (i.e. the sand fraction) would be deposited on the bed of the lower Río San Juan – perhaps 200 to 400 m^3 y^{-1}. This is consistent with Dr Kondolf's estimate above and further reinforces that any additional sedimentation due to construction of the Road would be indiscernible.

8.61. It is immediately obvious that the addition of Road-derived sediment to the annual sediment load of the lower Río San Juan could not have impeded navigation or required Nicaragua to dredge the River for this of any other purpose.

(5) Inputs of Road-derived sediment are not just insignificant, they are undetectable

8.62. As established in Section 8.B, the annual load of the Río San Juan is not constant year-on-year but is different every year because it responds to natural variability in rainfall, runoff, erosion and channel evolution. Analysis of suspended sediment records in the Río Colorado immediately downstream of the Delta between 2010 and 2013 indicates that while the average annual suspended sediment load is currently 5 981 000 t y^{-1}, the 95% confidence interval on that average value is 5 181 000 to 10 585 000 t y^{-1} due to uncertainty and natural variability in the measured data. This means that there is a 95% probability that the SSL carried in any year will be between 5 181 000 and 10 585 000 t, but there is a 5% chance that it could be still higher or lower than this. Variability in annual bedload is unknown, but is likely to be similar or greater than that in the suspended sediment load. It follows that using variability in SSL to represent that in total load (i.e. suspended sediment plus bed loads) is conservative.

8.63. These figures reveal that the annual total sediment load of the Río Colorado will probably be within about +/- 20% of the mean value, 95% of the time. As around 90% of the discharge in the Río San Juan passes to the Río Colorado, it follows that the 95% confidence interval on the mean annual sediment load of Río San Juan must also be around +/- 20%. Similarly, as 100% of the discharge passing through the lower Río San Juan comes from the Río San Juan, the 95% confidence interval on its annual sediment loads is also likely to be about +/- 20%.

8.64. In this context, the increase of less than 1% predicted based on ICE's analysis for delivery of road-derived sediment to the Río San Juan falls well within the range of natural variability of sediment loads in the River represented by a confidence interval of +/- 20%, meaning that even if such a change in load were to occur it would be practically indiscernible and statistically undetectable in records of measured loads. This would still be the case if Dr Kondolf's estimate were accepted, which it is not.

8.65. The bed of the lower Río San Juan is formed in mobile sand, self-organised into ripples and dunes with amplitudes ranging from centimetres up to a metre or more, respectively. The bed also features natural scour pools and depositional bars that cause in-channel depths to vary locally by one to several metres. It follows that a change in the rate of sedimentation by less than 0.2 mm y^{-1} (which is less than the diameter of a single sand grain) or even 100 times this (that is 20 mm y^{-1}, which is less than the amplitude of a ripple bedform) would be imperceptible in the field and immeasurable using a conventional echo-sounder.

E. Sediment budget of the Río San Juan and the possibility of reach-scale sediment impacts

8.66. On page 8 (paragraph 3) of his Third Report, Dr Kondolf alludes to the finding reported by Reid and Dunne (2003) that, "road-related sediment can dominate the sediment budget in many rivers."

8.67. As a general proposition and in the abstract, I agree with this statement. But Reid and Dunne were not referring to the Río San Juan. In Sections 8.B and 8.D above, it is explained that even accepting Dr Kondolf's upper-bound estimate of the contribution of sediment from the Road to the Río San Juan (182 030 t y^{-1}), this constitutes only about 2% of the annual sediment budget for this specific River. Road-related sediment may dominate the sediment budget in many rivers, but the Río San Juan is not one of them.

8.68. Notwithstanding this, there is more to the sediment budget of a river than the average annual load measured downstream in the system, and it could be argued that while the contribution of Road-related sediment is tiny in comparison to the average annual load measured downstream at La Trinidad or the Delta, it might be significant when compared to the average annual load carried by the River in the immediate vicinity of the Road, which is someway upstream. To examine whether this could be the case, it was necessary to construct a spatially referenced sediment budget in the manner pioneered by Dr Stan Trimble for Coon Creek, Wisconsin (Trimble 1983).

8.69. The starting point for construction of such a sediment budget is Table 6, which sets out the average annual loads of suspended, bed and total loads in the Río San Juan, Río Colorado and lower Río San Juan. This Table is reproduced here for ease of reference.

Table 6. Current average annual total loads in the Rio San Juan - Colorado

River	Suspended load t y^{-1}	Bed load t y^{-1}	Total Load t y^{-1}
San Juan	6 573 000	2 559 000	9 133 000
Colorado	5 981 000	2 488 000	8 470 000
Lower San Juan	592 000	71 000	663 000

8.70. Unfortunately, the spatial distribution and periods of record for which sediment transport data are available at other points along the mainstream and in the major tributaries are insufficient to support construction of a sediment budget. Therefore it is necessary to estimate the sediment yields from the major Costa Rican and Nicaraguan tributary basins, and then use the available measured data to balance the sediment budget. These estimates are based on rigorous use of appropriate sediment models, and their application benefitted from the insight and sound judgment of the engineers at ICE, who are highly experienced in construction of reliable sediment budgets for Costa Rican rivers in the context of their work in designing sustainable hydropower dams and reservoirs.

8.71. Tributary sediment yields due to sheet and rill erosion in basins draining from Costa Rica (Frío, Pocosol, Infiernito, San Carlos, Cureña, Sarapiquí and Chirripó) and Nicaragua (Melchora, Sábalos, Santa Cruz, Bartola, Caño Machado and Caño Las Banderas) were estimated using the Calibrated Simulation of Transported Erosion (CALSITE) model (Bradbury et al., 1993). This model employs the Universal Soil Loss Equation (USLE) which is by far the most widely applied method for predicting land surface erosion by surface runoff, worldwide (Wischmeier and Smith, 1960). When calibrated (as in this application) the USLE works well, though it is important that the person responsible for its application has experience in avoiding potential pitfalls that can lead to unreliable results. The modelling at ICE was led by Federico Gómez Delgado, who has over a decade of experience in using the USLE and CALCITE models. Application of the CALSITE model in the management of multiple hydropower development and catchment management plans (Gómez-Delgado, 2002 and 2004; Gómez-Delgado et al., 2011; Marchamalo et al., 2007 and 2012), has demonstrated the coherence and reliability of this model for determining the sheet and rill component of the basin sediment yield in the Río San Juan (and other) basins. Full details of the modelling may be found in section 5 and Appendix H of the 2013 ICE Report. For these reasons, I consider the criticism made by Dr Kondolf in his Fourth Report that the estimates derived from the USLE are "notoriously inaccurate" to have no relevance to the ICE Report.

8.72. However, CALCITE does not account for the input of coarse sediment moving through the tributaries as bed load. Measurements of suspended and bed loads at the Delta Colorado station indicate that the suspended load of the Río San Juan is about 2.5 times larger than bed load. On this basis, the bed load contributions of the major basins were approximated as being 40% of the suspended load. With respect to bed load, it was assumed that the Lake Nicaragua does not provide significant bed load to the Río San Juan due to its large size and high trap efficiency for coarse sediment.

8.73. The results of CALCITE modelling and estimation of bed load inputs based on the predicted suspended sediment loads in the tributaries to the Rio San Juan are summarised below, in Table 15.

Table 15. Annual sediment inputs (suspended and bed loads) to the Río San Juan from Lake Nicaragua and its tributary basins based on CALCITE modelling (from 2013 ICE Report).

Basin	Suspended load ($t\ yr^{-1}$)	Bed load ($t\ yr^{-1}$)	Total load ($t\ yr^{-1}$)
Major Costa Rican basins draining directly to the Río San Juan			
Frío	269 000	108 000	377 000
Pocosol	49 000	20 000	69 000
Infiernito	78 000	31 000	109 000
San Carlos	1 824 000	730 000	2 554 000
Cureña	23 000	9 000	32 000
Sarapiquí	458 000	183 000	641 000
Chirripó	27 000	11 000	38 000
Major Nicaraguan basins (inc. Lake Nicaragua) draining directly to the Río San Juan			
Melchora	278 000	111 000	389 000
Sábalos	366 000	146 000	512 000
Santa Cruz	244 000	98 000	342 000
Bartola	23 000	9 000	32 000
Machado	44 000	17 000	61 000
Las Banderas	31 000	12 000	43 000
Lake Nicaragua	365 000	-	365 000
Summary for Río San Juan - Colorado system			
Total	4 079 000	1 485 000	5 556 000

8.74. The total sediment load in Table 15, based on application of CALCITE and the assumption that bed load is about 40% of the suspended load, is 5 556 000 $t\ y^{-1}$. This is lower than the total load estimated for the Río San Juan -

Colorado system based on measured loads at the Delta Colorado station, which is 9 133 000 t y^{-1}. The difference is easily explained by the fact that the CALSITE model accounts only for *sheet and rill erosion*; it does not predict the basin sediment yield due to larger scale erosion processes such as *mass wasting and gully erosion*, which are processes observed to occur throughout the region.

8.75. To balance the budget, the deficit (3 567 000 t y^{-1}) may be attributed to landslide and gully erosion. This suggests that surface erosion (sheet and rill) and mass wasting/gullying contribute approximately equally to the yield of fine sediment from the tributary basins, which is not an unreasonable finding. Also, problems occur when components of a sediment budget are small numbers estimated based on the difference between two large numbers. This is not the case here as the contributions of surface erosion and mass wasting/gullying are commensurate in size. For these reasons, closing the budget in this way is acceptable. The balanced sediment budget is listed below in Table 16.

Table 16. Annual sediment inputs (suspended and bed loads) to the Río San Juan from Lake Nicaragua and its tributary basins adjusted to obtain balance the sediment budget (from 2013 ICE Report).

Basin	Suspended load ($t\ yr^{-1}$)	Bed load ($t\ yr^{-1}$)	Total load ($t\ yr^{-1}$)
Major Costa Rican basins draining directly to the Río San Juan			
Frío	433 000	185 000	618 000
Pocosol	79 000	34 000	113 000
Infiernito	126 000	54 000	180 000
San Carlos	2 939 000	1 257 000	4 196 000
Cureña	37 000	16 000	53 000
Sarapiquí	738 000	316 000	1 054 000
Chirripó	44 000	19 000	63 000
Major Nicaraguan basins draining directly to the Río San Juan			
Melchora	448 000	192 000	640 000
Sábalos	590 000	252 000	842 000
Santa Cruz	393 000	168 000	561 000
Bartola	37 000	16 000	53 000
Machado	71 000	30 000	101 000
Las Banderas	50 000	21 000	71 000
Lake Nicaragua	588 000	-	588 000
Totals for Río San Juan - Colorado system			
Río San Juan	6 573 000	2 559 000	9 133 000
Río Colorado	5 981 000	2 489 000	8 470 000
lower Río San Juan	592 000	71 000	663 000

8.76. The sediment budget set out in Table 16 is shown graphically in Figure 32. In this diagram, the average annual supply of sediment from each tributary is labelled (in tonnes) and represented by an inward arrow, the width of which is proportional to the magnitude of the average annual sediment input. The average annual supplies of sediment to the Río Colorado and lower Río San Juan downstream are also labelled (in tonnes) and represented by outward arrows that are similarly scaled on the relevant sediment loads. The legend and map in Figure 24 define the tributary rivers and locations of their basins, respectively. It follows that in Figure 24, the width of the body of the diagram, which represents the average annual load transported by the Río San Juan, increases left to right as the tributary inputs add to that load.

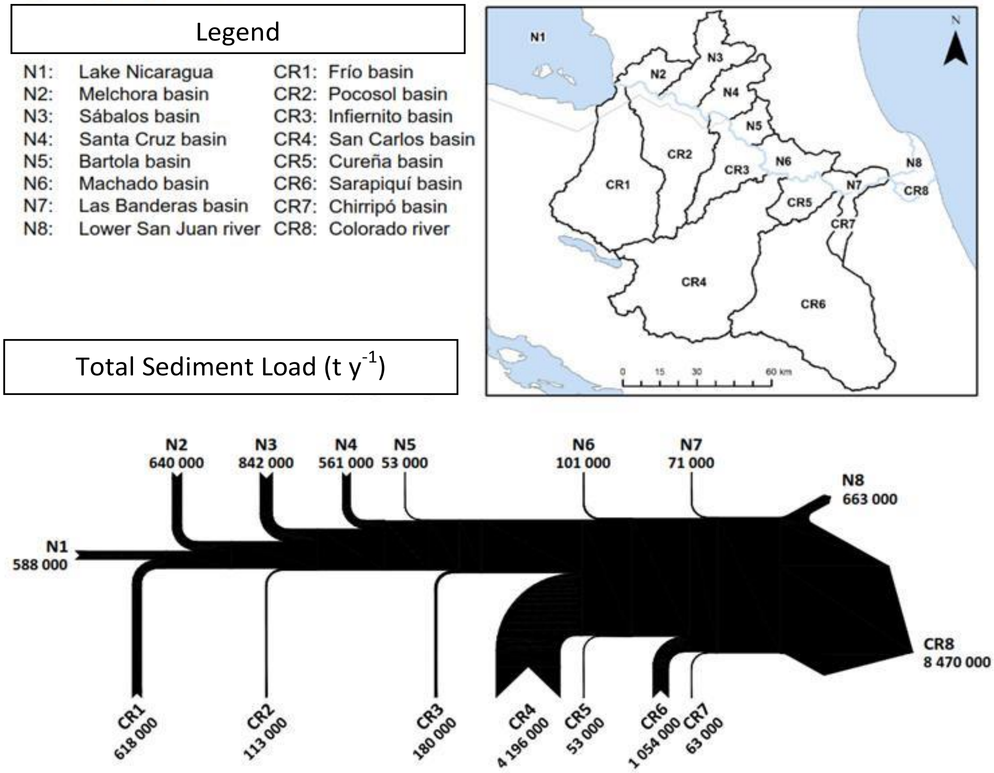

Figure 32. Sediment budget for the Río San Juan including inputs from the Road (from 2013 ICE Report). Labels indicate average annual inputs and outputs in tonnes.

8.77. The sediment budget set out in Table 15 and illustrated in Figure 32 corresponds to the period December 2010 to June 2013, which means it reflects conditions following construction of Route 1856. In Section 8.C above the average annual inputs of sediment eroded from the Road (including the road bed, cut slopes, fill slopes and other disturbed areas) by all relevant processes (including sheet erosion, rill erosion, landslides and gullies) were calculated for each of the five major basins draining to the Rio San Juan along the entire length of the Road that parallels the River between marker II and the Delta. The results were listed in Table 14 and plotted in Figure 31.

8.78. A sediment budget for conditions that would have pertained had the Road not been constructed was obtained by subtracting the estimated inputs of sediment from the Road in each of the major basins (as listed in Table 14) from the relevant rows in the sediment budget in Table 15. The sediment budget for conditions without the Road is shown graphically in Figure 33.

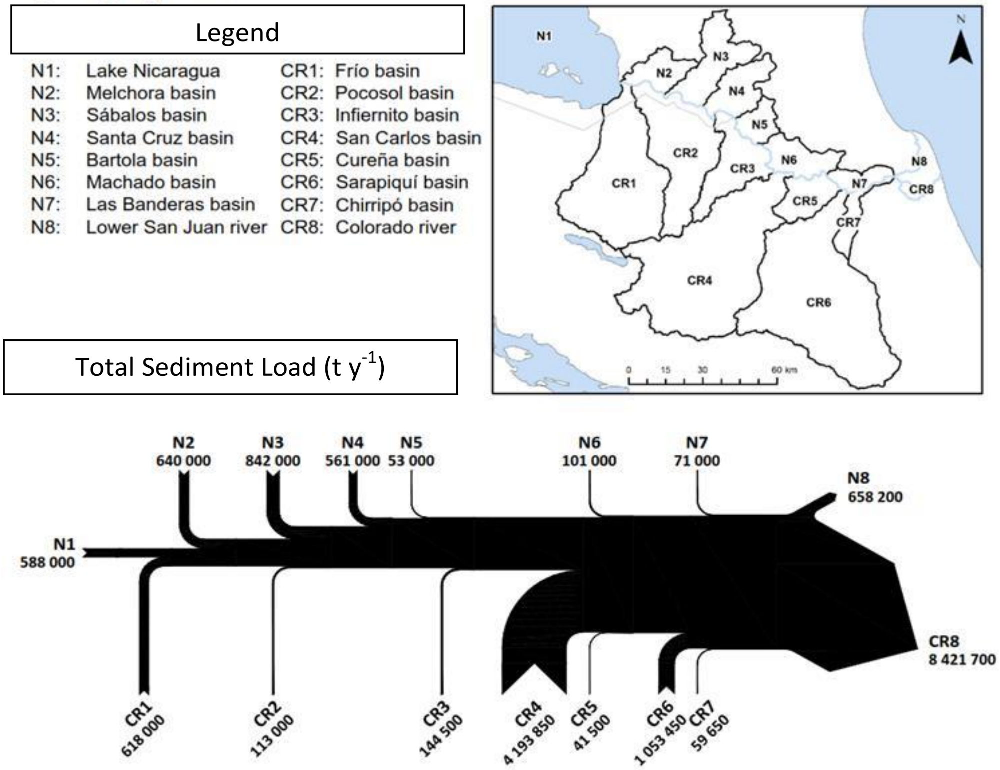

Figure 33. Sediment budget for the Río San Juan excluding inputs from the Road (from 2013 ICE Report). Labels indicate average annual inputs and outputs in tonnes.

8.79. Finally, the contributions made to the sediment budget from each of the five major basins draining to the Río San Juan along its length can be illustrated by the differences between the sediment budgets in Figures 32 and 33, and these are shown graphically in Figure 34. The narrow widths of the red bands in Figure 34 are correctly scaled and accurately portray that sediment inputs from Route 1856 in each reach are so small relative to natural loads in those reaches that they are not only difficult to see but inconsequential and practically undetectable.

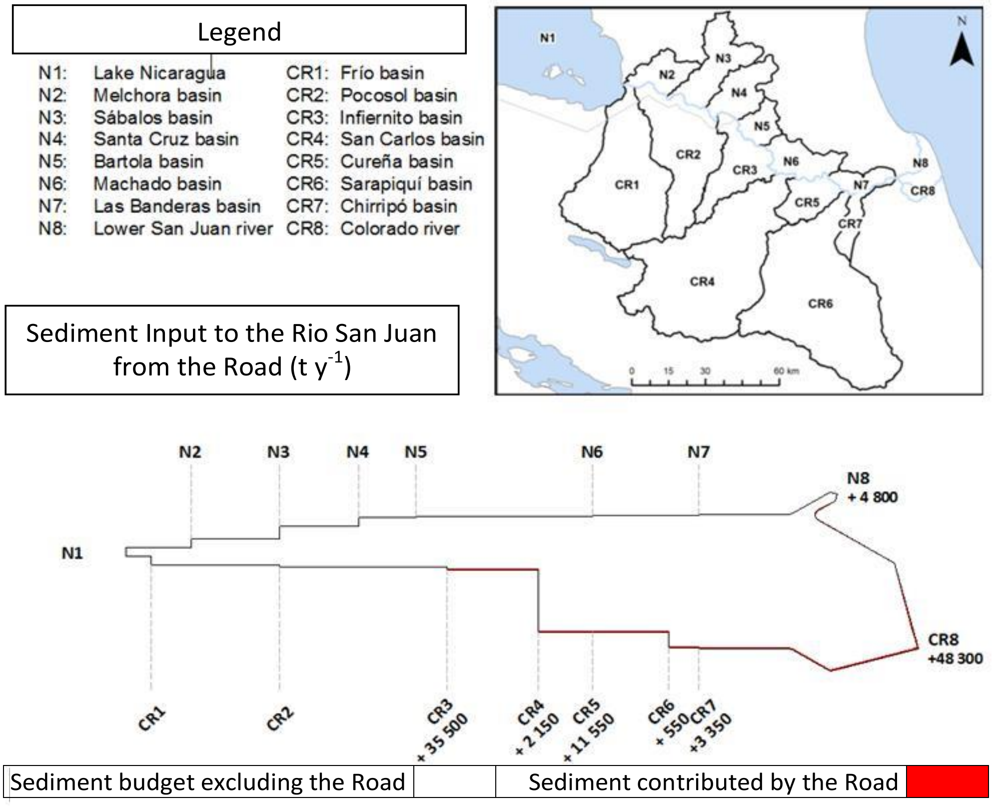

Figure 34. Sediment budget for the Rio San Juan – Colorado system highlighting the contribution due to construction of Route 1856 from each major tributary basin. Inputs of road-derived sediment are as labelled: for example, the largest input to the San Juan River is +40 300 t y-1 from CR5 (the Infiernito Basin). The narrow widths of red bands are correctly scaled and accurately portray that sediment inputs from Route 1856 in each reach are so small relative to natural loads that they are not only difficult to see but inconsequential and practically undetectable (from the 2013 ICE Report).

8.80. Based on this exhaustive investigation and the sediment budget that has been constructed, it is abundantly clear that the addition of sediment eroded from the Road is insufficient to significantly impact the sediment budget not only at the system scale, but also in Río San Juan in the vicinity of the Road.

9. Has construction of the Road had any significant impacts on channel morphology in the Río San Juan?

A. Sediment deltas observed in the Río San Juan following construction of Route 1856

9.1. The 2012 Kondolf Report makes reference to deltas of sediment eroded from the Road that were observed along the right (Costa Rican) bank of the River in October 2012. The few photographs are included in that report to illustrate these deltas do not demonstrate that the Road was having a significant morphological impact on the Río San Juan. Four of the photographs from the 2012 Kondolf Report are reproduced here to illustrate the small dimensions and morphological insignificance of the deltas observed in October 2012.

Figure 35. Photographs reproduced directly from Appendix B of the Kondolf Report. Dr Kondolf presumably selected them to be representative of the deltas of Road-derived he observed in October 2010. If so, the deltas he observed appear small and inconsequential in the context of this large River.

9.2. On page of his Third Report (paragraph two), Dr Kondolf reports further observations related to the morphological impacts of the Road, reporting that during his May 2013 field visit he,

> "documented multiple 'deltas' of sediment eroded from the road, and carried by local streams or newly eroded gullies into the river."

9.3. On this occasion, he supported his textual account with a large number of photographs, included in Appendix A to the Third Report.

9.4. In my 2013 Report submitted in response to Nicaragua's request for the indication of Provisional Measures in the *Construction of Road Case*, I opined that I was unsure of the basis on which Dr Kondolf could be certain that all of the deltas documented in the photographs in Appendix A were composed entirely or even predominantly of *'sediment eroded from the road'*. In a subsequent written response (the Fourth Kondolf Report), Dr Kondolf agreed that the source of the sediment in the photographs was not always clear and that in many of them it was impossible to see a link to the Road that was obvious in the field. He also drew attention to the fact that the existence of the deltas could be causally linked to erosion of the Road because the sediment comprising them was more angular than that sourced higher in the catchment, delivered by tributary streams and rounded in the process. This is an argument I understand and accept, at least for particles of gravel size or larger.

9.5. Having accepted that, I remain convinced that by no means all the sediment deltas observed by Dr Kondolf along the right bank of the Río San Juan between Marker II and Boca San Carlos in May 2013 exist *solely* because of the addition to the River of sediment eroded from the Road.

9.6. As noted in paragraph 3.3 above, I also participated in an overflight of the Road in May 2013, and I also noticed multiple deltas of sediment. However, many of the deltas I noticed were along the left bank line of the Río San Juan, on the Nicaraguan side. And several of them appeared larger and considerably more prominent than those documented in Appendix A (Figures 36 to 38 show examples). These deltas are composed of sediment eroded from Nicaraguan territory and deposited in the Río San Juan by Nicaraguan tributaries. They cannot be deltas of sediment eroded from the Road.

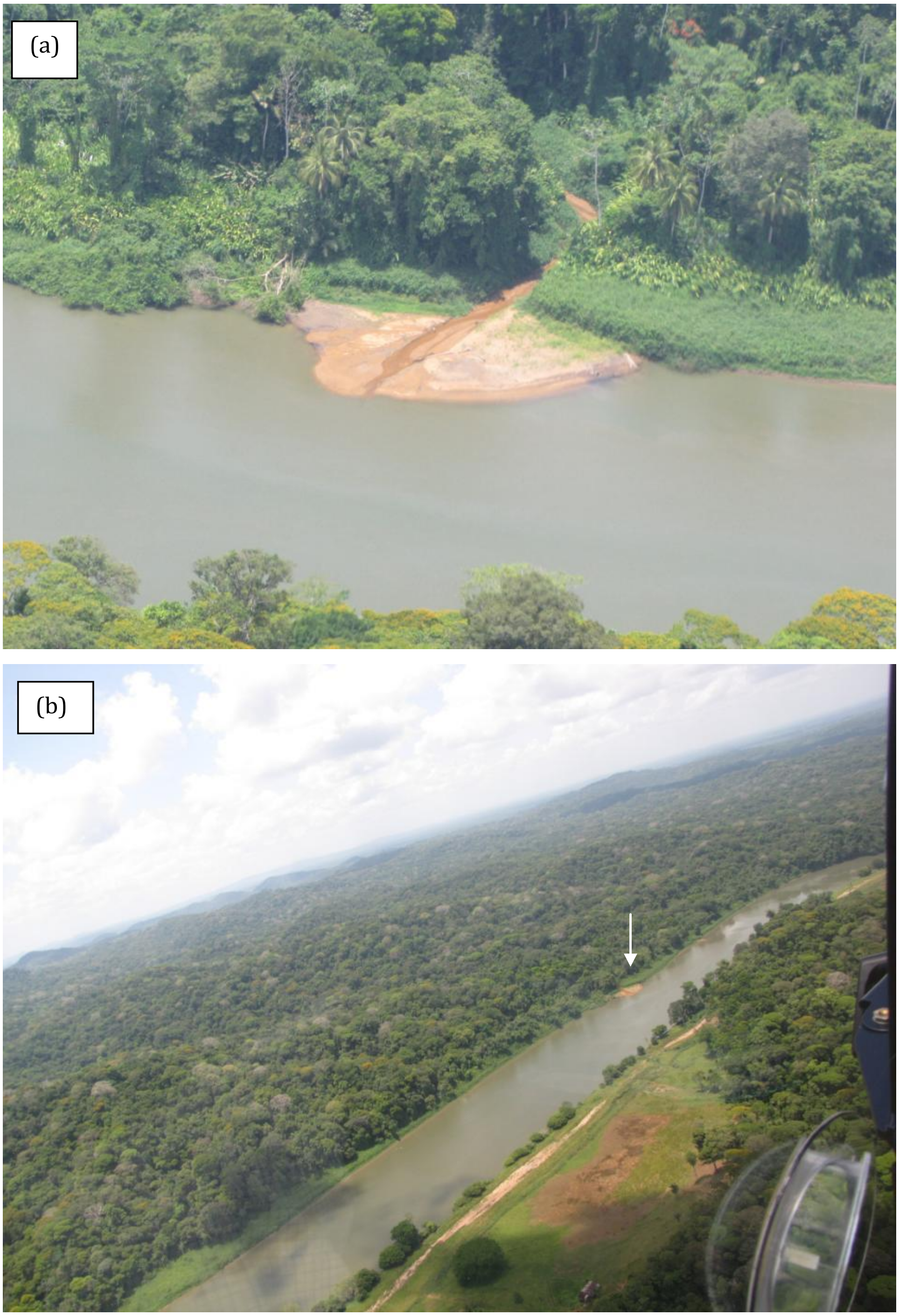

Figure 36. Prominent sediment delta observed in the Río San Juan from a helicopter in Costa Rican airspace on 7 May 2013 (a) close up and (b) wide angle view showing clearly that this delta is on the left (Nicaraguan) bank of the River. Route 1856 is clearly visible on the right (Costa Rican) side of the River (both photographs by author).

Figure 37. Sediment delta observed in the Río San Juan from a helicopter in Costa Rican airspace on 7 May 2013 (a) close up. (b) wide angle view showing clearly that this delta is also on the far (Nicaraguan) bank of the River. Route 1856 is clearly visible on the near (Costa Rican) side of the River (both photographs by author).

Figure 38. Photographs taken from Costa Rican air space on 7 May 2013. These show that deltas of sediment occur at most of the left bank tributaries of the Río San Juan between Marker II and Boca San Carlos. The deltas are unrelated to the Road and are formed by sediment delivered to the Río San Juan by streams draining catchments entirely within Nicaraguan territory.

9.7. Without speculating on the origins of the sediment that builds deltas at tributary mouths along the Nicaraguan bank of the Río San Juan and whether these are natural or anthropogenic sources, the presence of multiple deltas that cannot be composed of sediment eroded from the Road demonstrates that deltas in this River are not exclusively or even predominantly caused by deposition of additional sediment eroded from the Road.

9.8. On the contrary, deltas are part of the natural sediment transfer system along the channel of the Río San Juan. They form when local rainstorms produce sediment-laden runoff from tributaries, the coarse fraction of which is deposited in the lower course of the tributary channel and around the tributary's confluence with the Río San Juan. As Dr Kondolf notes, that deposition is temporary – deltaic sediments are re-eroded and transported downstream, diffusing into the receiving river's sediment load during the next significant sediment transport event in the main river.

9.9. In any case, the limited size and relatively wide spacing of the tributary deltas I observed along both banks of the Río San Juan in May 2013 means that they do not harm the River. Indeed, to the contrary, tributary bars and deltas are beneficial to the aquatic and riparian ecosystems because, for example, they provide fresh habitats and open niches for pioneer plant species – for example, as illustrated in photographs 1018, 1043 and 1046 in Dr Kondolf's 2013 Appendix A (to his Third Report).

9.10. The potential for any other morphological responses to changes in the sediment supply to the Río San Juan upstream of Boca San Carlos is effectively zero because (for the reasons set out in Section 6.C) the River between Lake Nicaragua and the Rio San Carlos is composed of a series of three *transport* reaches, in which channel form, elevation and slope are controlled geologically. Downstream of Boca San Carlos, the River is composed of *response* reaches within which channel form is controlled by the sediment regime (as described in Section 6.C). However, that regime is dominated by high and variable sediment inputs from the San Carlos and Sarapiquí basins, which supply the vast majority of sediment carried by the River. The contribution from the Road is far too small to have any discernible impacts.

10. Has the Road impacted the Ecology or Fishery of the Río San Juan, or had any effect on Tourism?

10.1. In addition to the statements made in Nicaragua's Memorial and the 2012 Kondolf Report, in his Third Report Dr Kondolf makes further reference to the impacts of road construction in rivers other than the Río San Juan. For example, on page 7 (paragraph 2) of his Third Report, he writes that ecological impacts stem from,

> "The combination of hydrological effects and increased erosion and sedimentation from road construction that result in significant increases of sediment loading to rivers and streams, which in turn, have been documented to cause a range of serious environmental problems."

10.2. And in paragraph 5 on page 7,

> 'The delivery of massive volumes of sediment to rivers has resulted in significant ecological damage."

10.3. These statements are entirely general in their terms and are only relevant to road construction that delivers increases in sediment loading that may justifiably be described as *massive* or at the very least *significant*. As explained in Chapters 6, 7, 8 and 9 above, hydrologic impacts of the Road on the Río San Juan are infinitesimal; its sediment impacts are undetectable, its impacts on navigation are non-existent; and its morphological impacts (in building deltas that temporarily store coarse sediment) are insignificant, and in any case not necessarily adverse. In no sense can any of the Road's impacts be described as massive or even significant. Considering uncertainty in the hydrology, sediment load and in-channel storage of sediment associated with natural variability in the annual load the impacts of the Road are not only negligible, they are indiscernible.

10.4. On page 11 (paragraph 2) of his Third Report, Dr Kondolf reports suspended sediment concentrations in three samples of muddy-water in plumes in the River, which had entered the River following a 15-minute downpour. The samples had SSCs of 364, 459 and 483 grams per cubic metre. Dr Kondolf describes these SSCs as '*high*'. He also took two samples of River water, both of which had SSCs of 8 grams per cubic metre. Section 6.E(1) of this Report includes data from not five SSC samples, but 2 409. Table 4 lists the sources of SSC data for the Río San Juan and its Costa Rican tributaries and these data were graphed in Figure 18.

10.5. The SSCs measured in this larger data set vary from less than 10 ppm (or grams per cubic metre – the two measures of SSC are equivalent) to more than 10 000 ppm. While the background SSC in the River as measured by Dr Kondolf was indeed low, the concentrations in the plume of muddy-water are not high in the context of SSCs routinely observed in runoff draining to the Río San Juan, or even in the River itself.

10.6. I am not surprised that a 15-minute rainstorm in May produced a striking contrast between SSCs in local runoff and the receiving water because under these circumstances the source of sediment is localised to the area of the rainstorm while discharge and background SSCs in the River (which in May is at its lowest (base flow) discharge – see Figure 14 above) are at their lowest. However, the volume of muddy water is a tiny fraction of even the lowest discharge in the Río San Juan and turbulent mixing would ensure that the *relatively high* SSC decreases to background levels within a short distance downstream and a short time after the rainstorm ends, as the plume of local runoff diffuses into the far greater flow in the receiving water.

10.7. In his Fourth Report, Dr Kondolf accepted that the sediment concentrations he measured in the muddy plume, "were not very high compared to concentrations measured in the river and its large tributaries during high flows."[12] In doing so, he effectively retracts the statement in his Third Report that these measurements showed, "that the runoff from the road carried high suspended sediment contributions".[13] Dr Kondolf went on to state in his Fourth Report that the measurements, "demonstrate the essential fact that sediment from the road is entering the Rio San Juan."[14] I agree, but the central point

[12] Fourth Kondolf Report, p. 11.

[13] Third Kondolf Report, p. 11.

[14] Fourth Kondolf Report, p. 11.

remains this: in order to assess the whether the concentrations of suspended sediment measured in runoff from the Road have harmed or may in future cause harm to life in the River, it is necessary to consider them within the context of sediment concentrations that aquatic plants and animals in the river system experience routinely and to which they are well adapted. The analysis conducted herein demonstrates that concentrations often exceed 500 grams per cubic metre and so those measured in May 2013 (364, 459 and 483 grams per cubic metre) have not, and will not damage life in the River.

10.8. With two exceptions, the Third Kondolf Report adopts a descriptive approach in presenting a literature review of the impacts of road building on rivers other than the Río San Juan (much of which is similar or even identical to material presented previously in the 2012 Kondolf Report), together with textual commentary and a virtual tour of the Río San Juan, both of which (as in October 2012) extend only to 41.6 km of the Road between Marker II and Boca San Carlos. The five suspended sediment samples measured in the muddy plume constitute one exception to this approach.

10.9. The second exception is the reported results of research done by Dr Kondolf's colleague, Dr Rios, who sampled the periphyton at nine sites, in late May 2013. On page 13 (paragraph 1) of the Third Kondolf Report, Dr Kondolf explains that four samples came from the deltas assumed to be composed of sediment eroded from the Road on the south (Costa Rican) bank of the River. The text is less clear concerning the nature of the sample sites on the north (Nicaraguan) bank. Dr Kondolf states that these were "five sites draining relatively undisturbed landscapes."

10.10. What the text does not make clear is whether those sites were on any of the multiple deltas I observed at the Nicaraguan side of the River earlier that month (as illustrated in Figures 36-38 above). If they were, then it would be a fair to compare them to deltas at the south bank; if they were not then the comparison between these samples taken at the north and south banks is inapt.

10.11. In the concluding part of paragraph 4 on page 2 of his Third Report, Dr Kondolf makes reference to irreversible harm done to salmon by massive mining in California and extensive logging in the Pacific Northwest. This contrasts with statements in the 2012 Kondolf Report that attribute the demise of pacific salmon populations in the USA to road building alone, which (as pointed out in Section 6 F) was not the case. But, as explained in the CCT Report, there are no salmon in the Río San Juan and in any case construction of a Road that increases the impermeable area in the Costa Rican basins draining to the Rio San Juan by 0.05% cannot be compared to the catchment-wide practices of hydraulic mining and clear-cut forestry that occurred in California and the Pacific Northwest.

10.12. Putting the evidence together, I can find nothing to support the statement made in paragraph 4 on page 2 of the Third Kondolf Report that Dr Kondolf and his team, "already see extensive, severe environmental damage."

10.13. With regard to the possibility that the Road has significantly damaged the Río San Juan, this statement seems inconsistent with the photographs in the 2012 Kondolf Report and the Third Kondolf Report, let alone the evidence provided throughout this report, which is supported by data, mapping and modeling provided in the accompanying reports mentioned in paragraph 3.3.

10.14. Nevertheless, it is still appropriate to précis some of the key findings of the 2013 CCT Report, as they pertain to the premise that there has already been 'extensive, severe environmental damage' to the Río San Juan.

10.15. In their comprehensive investigation, CCT examined the impacts of the Road on terrestrial and aquatic environments with complex ecosystems and food webs. They employed field work that included scientific sampling and analysis, together with over flights and application of the maps of land use change and inventories of slopes and watercourse provided in the 2013 *Land Use Change Report* and *Inventory of Slopes and Water Courses*, respectively. However, the great majority of the observations, data, analyses and conclusions in the CCT Report pertain to the Road's environmental and ecological impacts within Costa Rica. These impacts are assessed as being irrelevant in five of eight categories and moderate in three. Moderate impacts were mostly confined to the stretch of the Road between Marker II and Boca San Carlos, with a few micro-basins between Boca San Carlos and Boca Sarapiquí being moderately impacted. There were no impacts at all between Boca Sarapiquí and the Delta. Moderate impacts were limited to tree cutting in previously disturbed primary and secondary forests (along about 25% of the Road), and increased turbidity and disturbance of micro-habitats in some water bodies, due to localized sedimentation. These findings are important in helping to inform on-going planning and implementation of mitigation works (as described in Section 11, below). However, they are of no relevance to the Río San Juan, and so are not mentioned again herein.

10.16. CCT were prevented from evaluating environmental and ecological conditions in the Río San Juan itself because,

> "the Government of Nicaragua did not allow the scientists that conducted this study to enter Nicaraguan territory along the San Juan River in order to conduct sampling."[15]

10.17. Although it was not possible to prepare a matrix of potential impacts based on field data, for the reasons set out below, CCT concluded that,

> '"it is not considered there could be any significant impact on the San Juan river."[16]

10.18. CCT concluded that the Road has not had any significant, adverse impacts on the Río San Juan for the following reasons:

(a) Sediment transport and sedimentation are natural processes that play important roles in the aquatic environments of lowland, tropical water bodies, wetlands and rivers like those in this region.

(b) In lowland tropical rivers with high and variable sediment loads, resident species of macro-invertebrates and fish have adapted to conditions of high sedimentation, giving them a high tolerance over prolonged periods (see, for example, Connolly and Pearson, 2007).

15 CCT Report, p. 139, para. 3.

16 CCT Report, p. 139, para. 4.

(c) The Environmental Diagnostic Assessment indicated that impacts would not be expected in the Río San Juan even at an irrelevant (insignificant) level, due to the much larger volume of water this watercourse conveys, its greater depth and the high degree of adaptation of aquatic organisms that inhabit the River.

10.19. These findings extend to the potential for the Road to have adversely impacted the fishery in the Río San Juan. Potential impacts on sport fishing are dealt with below in paragraph 10.21 on Tourism. CCT identified no commercial fishing activities along the River in the study area. Fishing activities from Marker II to Delta Costa Rica consitute sporadic, subsistence fishing and there is no evidence that they have been adversely impacted by construction of the Road.

10.20. On page 110 and in conclusions 12 and 13 on page 156, CCT point out that it is currently impossible for any scientific study to demonstrate the possibility of there being adverse ecological impacts on the Río San Juan due to construction of the Road. This is because to do so would require the establishment of threshold levels for tolerance, morbidity and mortality of key species in the River with regard to sediment and sedimentation, a process that has not been undertaken to date and which would take several years to complete.

10.21. CCT's conclusions with respect to the possible impacts of the Road on tourism are unequivocal. First, it is important to note that there are no facilities for tourists on either bank of the Río San Juan between Marker II and Delta Costa Rica. The potential for international tourism (including sport fishing) is low due to lack of appropriate accommodation and infrastructure, poor access, and the perception of insecurity generated by press reports of border disputes between Costa Rica and Nicaragua. CCT were unable to find any evidence of a reduction in visitor numbers that could be attributed to construction of the Road and conclude in conclusion 14 on page 158 that,

> "The effect of the construction of Route 1856 has no direct impact on tourism in recent years."

11. Mitigation Works

A. Observations of the Mitigation Works in May 2013

11.1. During my first visit to the Route 1856 in February 2013, I inspected mitigation works under construction at several points along the Road between Marker II and the Río Infiernito. At one site I spoke to senior engineers from CONAVI (http://www.conavi.go.cr/), who were supervising construction of an inboard drainage channel. We discussed proposals for further mitigation works and I was impressed by their appreciation of the challenges posed by erosion control, their wide experience in successfully meeting the challenges along roads in other parts of Costa Rica, their resolve to stabilize cut and fill slopes and manage runoff from them and the road bed along Route 1856, and their confidence that they knew how to achieve these goals. An engineer from MECO (the lead contractor: http://constructorameco.com) was present, as was an engineer with Durman (the contractor responsible for materials: http://www.durman.com/inicio.htm). Each of these individuals thoroughly understood the need to mitigate erosion at specific locations along the Road and they demonstrated a deep knowledge of both the materials (woven biodegradable geofabrics, coconut matting, silt fences, rock, concrete) and infrastructure (in-board and out-board drainage channels, culverted cross-drains etc.) appropriate to the site.

11.2. During my second visit to the Road in May 2013, I focused particularly on the 41 km stretch between Marker II and Boca San Carlos and, especially, on inspection of mitigation work performed by MECO and Durman under supervision by CONAVI since my February visit. I did so based on the focus on this stretch in the Kondolf Report, my own observations of eroding cut and fill slopes in this stretch in February 2013, and my conclusion that there were few eroding slopes along the Road between Boca San Carlos and the Delta. I was accompanied in the field by Mr Carlos Pereira who was at that time leading the mitigation effort on behalf of CONAVI. I also took the opportunity to inspect sites proposed for erosion monitoring by a team of experts from the Departments of Geology and

Civil Engineering at the University of Costa Rica (see the UCR Report for a full account of the erosion monitoring programme).

11.3. The first site I inspected was near Marker II, where the Road approaches the Río San Juan from the west. In February 2013 the Road corridor featured extensive areas of bare soil and a developing gully along the inboard edge (Figure 39a). In May the area had been transformed by recently completed erosion mitigation measures including a concrete-lined, in-board ditch to convey water draining off a relatively steeply sloping stretch of the road while preventing concentrated flow erosion, and coconut matting to protect the bare soil areas from raindrop, sheet and rill erosion, while allowing it to re-vegetate naturally Figure 39b.

11.4. On 15 February 2013 I observed a gully eroding into a fill prism located to the west of Marker II. This gully had formed due to concentrated runoff that between 2011 and May 2013 flowed across Route 1856 from a micro-basin that had been blocked temporarily during construction of the Road (Figure 40a). I noted at the time that the gully was draining to Costa Rican territory, and well away from the Río San Juan. When I revisited the same site on 7 May 2013 the gully was no longer there. A culvert had been installed to convey runoff from the micro-basin beneath the road and a concrete-lined channel had been constructed to carry it to the base of the fill slope. The surrounding fill slope surface had been protected from raindrop impact, sheet and rill erosion by extensive deployment of coconut matting, which is well suited to this purpose (Figure 40b).

Figure 39. The Road near Marker II (a) prior to mitigation work on 15 February 2013 and (b) on 7 May 2013 with mitigation measures in place: note in-board drainage channel and extensive biodegradable, erosion control matting. Photographs by author.

Figure 40. View down a large gully in a fill prism created by concentrated runoff from the Road draining to Costa Rican territory to the west of Marker II (a) in February when it was actively eroding and (b) in May when the gully had been back-filled and stabilized using a culverted cross-drain and concrete drainage channel, with coconut matting used to protect the surrounding fill slope from sheet and rill erosion. Photographs by the author.

11.5. The next location where erosion had been noted during the February field visit was about 6.4 km east of Marker II. At this stretch of road, runoff from a relatively steep stretch of road had created two gullies on the out-board slope and initial attempts at erosion control using geofabric had been unsuccessful. Also, runoff was eroding the unlined in-board ditch. If left untreated, there was a risk that scour in the inboard ditch might undercut the toe of a cut slope at the top of hill to trigger a landslide (Figure 41a). During the May visit I observed that extensive concrete drainage channels had been constructed to convey both out-board and inboard runoff down the steeply sloping stretch of road (Figure 41b). The channels were functioning as intended and there had been no further toe erosion of the cut slope, which appeared to be stable and unchanged from February.

Figure 41. Road at East 497867, North 325463 about 6.4 km east of Marker II (a) on 15 February when failure of geotextile slope protection had allowed concentrated out-board runoff from the Road to create two gullies and in-board runoff was undercutting a cut slope (b) on 7 May 2013 after construction of concrete-lined out-board and in board ditches. Photographs by author.

11.6. In February I observed a network of rills and gullies on an outboard slope about 6.6 km east of Marker II that extended from the edge of the road bed down slope to the rear edge of a terrace separating the slope from the bank of the Río San Juan (Figure 42a). Soil eroded from the gullies had accumulated on the terrace surface as a run-out deposit, though no flow, erosion or sediment transport was occurring on February 15 and I could not see evidence of Road-related sediment having reached either the bank or the river. When I returned on 7 May, there had been extensive mitigation work at this site (Figure 42b). The gullies had been replaced by an engineered drainage system consisting of concrete channels connected by drop structures and silt fences had been installed to prevent overland flow from driving sheet and rill erosion of the steepest parts of the outboard slope (Figure 42b). Further silt fencing and a sediment trap had been constructed at the base of the outboard slope, to prevent sediment eroded from the road bed or outboard slope from reaching the terrace separating the slope from the river bank.

Figure 42. Road at East 498072, North 325345, about 6.6 km east of Marker II (a) on 15 February 2013 showing a network of gullies on an outboard slope and sediment accumulated as a run-out deposit on the flat terrace surface separating the foot of the slope from the bank of the Río San Juan (b) on 7 May 2013 showing mitigation works in the form of concrete channels and drop structures to convey runoff from the road bed, and silt fences to protect the slope from sheet and rill erosion, lined out-board and prevent road-derived sediment reaching the terrace. A sediment trap had also been constructed at the downstream termination of the gully system to prevent sediment reaching the River, though this cannot be easily identified in the photograph. Photographs by author.

11.7. In February, I observed evidence of sheet and rill erosion adjacent to the road bed on a relatively steeply sloping stretch of the Road close to the Río Infiernito (Figure 43a). Although the lower part of the rilled area was re-vegetating naturally, I was concerned that this may not happen quickly enough to stabilize the slope during the 2013 summer wet season. In the event, the risk of serious future erosion at this site was reduced through a multi-element, engineering solution designed to manage surface water runoff from the road bed and adjacent disturbed slopes in an integrated manner (Figure 43b).

Figure 43. Road at East 502480, North 321561, close to the Río Infiernito (a) on 15 February when surface unmanaged runoff from the road bed and surrounding slopes disturbed during construction had caused sheet and rill erosion of bare soil surfaces. (b) The same stretch of road on 7 May 2013 after protection of the road surface using crushed rock, installation of silt fences to prevent sheet and rill erosion while directing down-slope surface runoff into concrete-lined outboard and inboard ditches. Photographs by author.

11.8. The final site in the stretch of road between Marker II and Boca San Carlos visited on the ground on 15 February was at a promontory featuring a monument to slain police officers at Crucitas just east of the crossing on the Río Infiernito. This is currently as far as Route 1856 is accessible by conventional 4-wheel drive vehicle. From this vantage point it was possible to observe the path cleared in preparation for construction of the Road to the east. The exposed soil surface was subject to sheet and rill erosion by unmanaged down-slope runoff (Figure 44a). On 7 May 2013, it was clear that erosion had been addressed using an integrated system of runoff management measures (Figure 44b) that featured regarding of the slope profile that removed the more erodible surficial soils, installation of silt fences across the slope to reduce the effective length of down-slope overland flow and direct runoff into a concrete-lined, outboard ditch.

Figure 44. Path cleared for the Road near Crucitas, just east of the Rio Infiernito (a) on 15 February when unmanaged runoff from the path cleared in preparation for construction of the road bed had caused sheet and rill erosion. (b) The same area on 7 May 2013 after installation integrated measures to manage runoff involving regrading, silt fences, and concrete-lined outboard ditch. Photographs by author.

11.9. Based on the observations of the Road on 15 February and 7 May 2013 that are reported above it may be concluded that, during the intervening period, significant and substantial engineering works were carried out at multiple locations along the Road between Marker II and the Rio Infiernito, including but not limited to those illustrated in Figures 39 to 44.

11.10. Further, it may be predicted that the rate of erosion of the Road will decrease further in future compared to that reported in the UCR Report and that the Road will become increasingly insensitive to heavier rainfall as time passes. This prediction is based on measurements of sediment production from newly constructed, unpaved roads on the island of St John in the Caribbean reported by Ramos-Scharron and MacDonald (2005). These measurements indicate that sediment production declines with time since construction of the road surface because runoff preferentially removes easily eroded particles, leaving behind larger and less erodible ones so that the surface progressively 'armours' itself to become less erodible through time. (See Figure 45 below.)

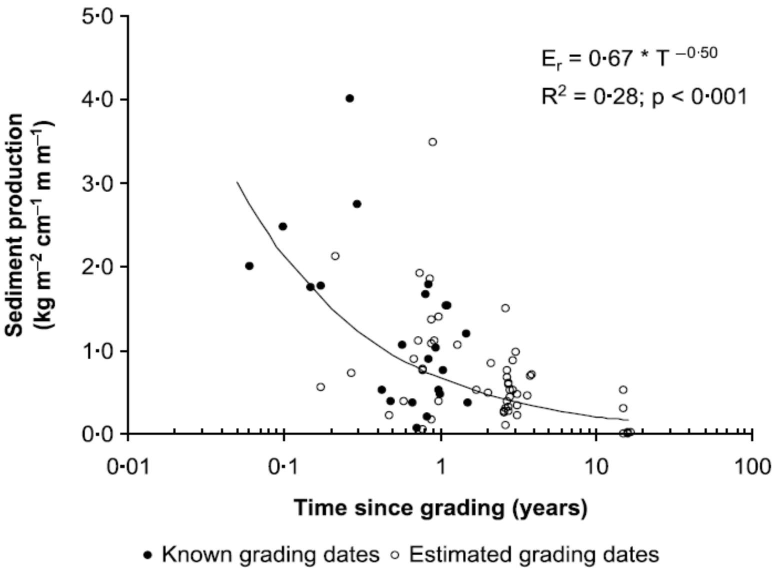

Figure 45. Relationship between sediment production per cm of rainfall and time elapsed since the road was constructed (or regarded) for a constant average road slope (from Ramos-Scharron and MacDonald, 2005).

11.11. Finally, the susceptibility to erosion of the Road will further decrease as extent to which its surface is covered by crushed rock increases.

11.12. For all these reasons, it seems certain that the future risks of erosion from the Road during heavier rainfall will decrease compared to those that pertained when construction of the Road was suspended.

B. Mitigation of future erosion risks and a permanent solution to erosion issues associated with the Road

11.13. In addition to the works I observed during my field visits, described in Section A immediately above, I am instructed that work is continuing to mitigate future erosion risks and to find a permanent solution to erosion issues associated with the Road. I note that the findings of the Environmental Diagnostic Assessment performed by CCT, which are included in their 2013 Report, indicate that further measures are necessary to control erosion from the Road in the future, in order to avoid environmental impacts within Costa Rica. In establishing whether appropriate plans are in place to achieve this, I have reviewed the following reports:

(a) Consejo Nacional de Vialidad (CONAVI), *Program for the Consolidation and Continued Improvement of Route No 1856*, Reference DIE-02-13-3107, 25 October 2013 (Annex [xx] to Costa Rica's Counter-Memorial);

(b) Report from Ana Lorena Guevara Fernández, Vice-Minister of the Environment, Costa Rica, to Enrique Castillo Barrantes, Minister of Foreign Affairs, Costa Rica, Reference DVM-293-2013, 8 October 2013 (Annex [xx] to Costa Rica's Counter-Memorial); and

(c) Comisión de Desarrollo Forestal de San Carlos (CODEFORSA), *Consulting Services for the Development and Implementation of an Environmental Plan for the Juan Rafael Mora Porras Border Road, Report of Activities to the Ministry of Foreign Affairs of the Republic of Costa Rica*, January 2013 (Annex [xx] to Costa Rica's Counter-Memorial).

11.14. These reports detail the continuing work to reduce erosion risks presented by the Road in the immediate and near future, i.e. the next one or two years.

11.15. I do not agree with the recommendation in the opening sentence of paragraph 4 on page 2 of the Third Kondolf Report that,

> "If work continues on Rte 1856, its impact will be devastating to areas directly affected and to downstream receiving waters."

11.16. On the contrary, I agree with the recommendations in the 2013 CCT Report that it is important that mitigation work continues in order to minimise the risk of future erosion and ecological impacts within some Costa Rican micro-basins, should heavier rainfall occur.

11.17. Based on my experience with engineered and biotechnical erosion mitigation works in other areas experiencing heavy rainfall, including Ethiopia, Bangladesh and the USA, my opinion is that the measures taken by Costa Rica have reduced and will continue to reduce the risk that significant erosion might occur during heavy rainstorms, compared to conditions immediately following construction of the Road. Consequently, I do not agree with the conclusion drawn in paragraph 3 on page 2 of the Third Kondolf Report that "erosion control and drainage works have been ineffective."

11.18. It is my understanding that the measures I observed in May 2013 are part of ongoing efforts intended to reduce erosion risks stemming from the way the Road was constructed in 2011 and that they are not intended to provide a permanent solution to erosion issues. Given that, my experience suggests that with appropriate inspection and, where necessary, maintenance or repair, the mitigation works will significantly reduce local erosion rates for the next year or two, allowing time for the work necessary to design, contract and build permanent works to progress.

11.19. However, these are temporary works that mitigate but do not permanently solve erosion problems, and a permanent solution will not be achieved until design, planning and construction of Road are completed. In my opinion, the necessary work should proceed as soon as possible, with the work expedited to the greatest degree, and consistently with Costa Rican legal and contracting practices.

12. Conclusions

12.1. Based on the scientific and technical studies reported herein, I conclude that the Road has had no significant impact on the hydrology of the Rio San Juan. At the micro-basin scale, changes in the permeability and hydrology of previously unmanaged basins are tiny and even when accumulated for all the affected basins there can be no impact on the Río San Juan. Around three quarters of the change in land use actually affects pasture rather than primary or secondary forest, so minimal hydrological impacts would be expected in any case.

12.2. The Road has had no significant impacts on sediment transport and dynamics in the Rio San Juan because the additional loads of sediment are tiny (less than 1%) compared to natural loads and are well within the ranges of natural variability (+/-20%) characteristic of this River, meaning they are in practice indiscernible.

12.3. In the reach upstream of Boca San Carlos the morphology of the Rio San Juan is insensitive to changes in the sediment load because it is a transport reach whose morphology is controlled by bed rock outcrops that form a cascade of rapids that fix the channel form, bed elevation, long profile and slope. This restricts morphological responses to changes in sediment input to the deposition and re-entrainment of the coarse fraction of the incoming load in temporary sediment deltas. My observations suggest that these deltas are actually larger and more frequent on the Nicaraguan side of the River. Downstream of Boca San Carlos, the Rio San Juan is a dune-ripple type river with a channel that is responsive to changes in sediment supply, but the sediment regime is completely dominated by naturally high inputs from the San Carlos and Sarapiquí basins.

12.4. There is absolutely nothing to suggest that the Road has adversely impacted the water quality, ecology or the fishery of the River. Biotic impacts would in any case be highly unlikely given that the abiotic impacts of the Road are insignificant. There is similarly nothing to suggest that there has been any impact on tourism.

12.5. There is no scientific justification for '*active efforts, including dredging, to maintain the capacity and quantity of the river's waters*' in the lower Río San Juan on the pretext of having to remove Road-derived sediment. Sediment transfer and deposition calculations based on measured data and conservative assumptions demonstrate that the additional amount of Road-derived sediment entering the lower Río San Juan is probably less than 1% of its total sediment load.

12.6. Sediment continuity dictates that even if all of this sediment were to be deposited on the bed of the channel, it would on average raise the bed of the river by less than 0.2 mm per year. In fact, deposition is spread over a much wider area of floodplain, wetlands and wash lands and an unknown but significant percentage of the load is discharged to the Caribbean Sea. Also, as the River has a sand bed, it is likely that only the sand fraction (which makes up 5 to 10% of the Road-derived sediment delivered to the River) would actually be deposited on the bed. Hence the estimates of increase sediment load and bed deposition in the lower Río San Juan are necessarily over-estimates. They are in any case well within the error margin for sediment measurements and calculations, and are small in comparison to inter-annual fluctuations in that are the product of natural variability.

12.7. Due to very small relative contribution of sediment in comparison to the heavy and highly variable sediment load in this River, the Road has not and will not in future pose a risk of harm to the hydrology, sediments, morphology, environment, or ecology of the River, all of which are well-adapted to the heavy load and highly variable sediment regime of the Río San Juan. That said, construction of the Route 1856 should be completed to the highest standards and as quickly as possible to provide a permanent solution to erosion issues along the Road.

13. References

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14. Statement of Independence and Truth

14.1. The opinions I have expressed in this Report represent my true and complete professional opinion. Where I have relied on the outputs of field and analytical work performed under my supervision by the technical team or facts supplied to me by those instructing me, I have noted this in my Report.

14.2. I understand that my overriding duty is to the Court, both in preparing this Report and in giving oral evidence, if required to give such evidence. I have complied and will continue to comply with that duty.

14.3. I have set out in my Report what I understand from those instructing me to be the questions in respect of which my opinion as an expert is required. I have done my best, in preparing this Report, to be accurate and complete. I have mentioned all matters that I regard as relevant to the opinions that I have expressed. I consider that all the matters on which I have expressed an opinion are within my field of expertise. I have drawn the attention of the Court to all matters, of which I am aware, which might adversely affect my opinion.

14.4. In preparing this Report, I am not aware of any conflict of interest actual or potential which might impact upon my ability to provide an independent expert opinion.

14.5. I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of this proceeding.

14.6. In respect of matters referred to which are not within my personal knowledge, I have indicated the source of such information.

14.7. I have not, without forming an independent view, included anything which has been suggested to me by others, including the technical team and those instructing me.

14.8. At the time of signing this Report I consider it to be complete and accurate subject to any qualifications noted herein. I will notify those instructing me if, for any reason, I subsequently consider that the Report requires any material correction or qualification.

14.9. I understand that this Report will be the evidence that I will give, if required, under oath, subject to any correction or qualification I may make before swearing to its veracity.

14.10. The substance of all facts and instructions given to me which are material to the opinions expressed in this Report or upon which those opinions are based are reflected in my Report.

14.11. I confirm that I have made clear which facts and matters referred to in this Report are within my own knowledge and which are not. Those that are within my own knowledge I confirm to be true. The opinions I have expressed represent my true and complete professional opinion.

……………………………………

Professor Colin Thorne

2 Parker Gardens
Nottingham
NG9 8QG
UK

December 2013

List of Attachments

Attachment 1 Curriculum Vitae of Professor Colin Thorne

Attachment 1

Curriculum Vitae - Colin Reginald Thorne

PERSONAL DETAILS

Home Address	2 Parker Gardens, Nottingham, NG9 8QG, UK
Nationality	UK

DEGREES

1974	BSc (Honours)	Environmental Sciences, Univ. of East Anglia Class: First
1978	PhD	Environmental Sciences, Univ. of East Anglia

AWARDS

1983	Faculty Award for Academic Excellence, Colorado State University
1986	Collingwood Prize, American Society of Civil Engineers

CAREER TO DATE

1977-79	Senior Research Associate, University of East Anglia, Norwich
1979-80	Visiting Scientist, USDA Sedimentation Lab., Oxford, Mississippi, USA
1980-81	Senior Research Associate, University of East Anglia, Norwich
1982-84	Associate Professor, Department of Civil Engineering, Colorado State University, Fort Collins, Colorado 80523
1984-2010	Affiliate Professor, Engineering Research Center, Colorado State University
1984-89	Lecturer, Department of Geography, Queen Mary College, University of London
1989-90	Reader, Department of Geography, Queen Mary College, University of London
1990-	Professor, Department of Geography, University of Nottingham
1993-96	Head of Department, Department of Geography, University of Nottingham
1998	Visiting Professor, Dept. Geography, University of Canterbury, Christchurch, NZ
1998-2001	Dean, Faculty of Law and Social Sciences, University of Nottingham
2001-	Concurrent Professor, Department of Geography, Nanjing University, China
2008	Visiting Scientist, NOAA Fisheries, Santa Rosa, California
2012-	Affiliate Professor, School of Geography, Portland State University, Oregon

REFEREED PUBLICATIONS

1975-2013 Seven authored and eight edited books, 175 refereed publications including journal papers (72), proceedings papers (61) and book chapters (47), plus over 130 research reports, 20 journal and published conference discussions, and numerous non-refereed papers, reports, book reviews and conference contributions.

PROFESSIONAL SOCIETIES AND SERVICE

American Geophysical Union (since 1980)
American Society of Civil Engineers (Affiliate) (since 1982)
British Society for Geomorphology (since 1974)
Trustee – Papplewick Trust and Water Education Trust (since 2008)
Member of Editorial Panel for the *Geographical Journal* (since 1999)

CURRENT RESEARCH STUDENTSHIPS, CONTRACTS AND GRANTS

Engineering and Physical Sciences Research Council, UK
Evaluating and delivering multiple flood risk benefits in Blue-Green Cities (2013-2016)
Three-year, multi-disciplinary research project to co-lead a consortium of universities in a UK£2 million research project concerned with improved management of urban flood risk. Blue-Green Cities are those that manage the urban water cycle holistically while integrating the design and management floodways and green spaces. The consortium led by Nottingham includes Cambridge, London, Leeds, Newcastle, HeRíot-Watt, West of England and Cranfield Universities. Work packages deal with: Effective stakeholder engagement and communications; Hydraulic, geomorphic and citizen modelling; Options appraisal for flood risk management, Multi-criteria evaluation of flood risk benefits, and; a Case study.

Economic and Social Research Council, UK
Water Literacy, citizenship and sustainable schools strategy: transition education for environmental sustainability (2010-13)
CASE studentship with Severn-Trent Water Ltd. and the Papplewick Trust.

Environment Agency-Department for Environment Joint Research Programme, UK
River Sediments and Habitats: Channel Maintenance and Habitats (2005-13)
Production of a Channel Management Handbook based on the results of a multi-year study to monitor a series of field investigations of the impacts of different river maintenance regimes on in-stream and riparian habitats. The Handbook uses findings from 5 field sites and maintenance practices covered include desilting, dredging, vegetation clearance and gravel extraction.

Mekong River Commission

PRíor Notification, PRíor Consultation and Agreement Process for Xayaburi Dam (2010-2013)

Leading Sediment Expert Group responsible for reviewing documents provided by proponent of the proposed dam and advising MRCS on preparation of reports to the Mekong River Joint Committee with respect to potential impacts of dam on Sediments, Morphology and Nutrient Balance.

Nottingham University, School of Geography (with Cascades Volcano Observatory, US Geological Survey and Portland District US Army Corps of Engineers)

Landscape Evolution Modeling of the Debris Avalanche generated by the 1980 Eruption of Mount St Helens, Washington (2010-13)

3-year studentship to support collaborative research with the US Geological Survey and US Army Corps of Engineers on future evolution of the drainage system of the North Fork Toutle River and consequential flood risks and their management in the Cowlitz River.

US Army Corps of Engineers (Portland District)

Geomorphic Assessment Evaluation of Island Building Structures on the SRS Sediment Plain, NF Toutle River

Assessment, evaluation and visualization of the morphological, sediment and ecological performance of fourteen large Engineered Log Jams (ELJ's) designed to promote grade building and create habitat on the sediment plain upstream of the Sediment Retention Structure on the North Fork Toutle River.

Republic of Costa Rica

Certain activities carried out by Nicaragua in the border area (*Costa Rica v.Nicaragua*) (2010-)

Expert witness input on a case filed with the International Court of Justice, The Hague.

Construcción de un camino en Costa Rica a lo largo del Río San Juan (*Nicaragua v. Costa Rica*) (2012-)

Expert witness input on a second case filed with the International Court of Justice, The Hague.

CURRENT TEACHING

Module	**Year**	**Details**
Earth and Environmental Dynamics	yr 1	Core Module (Convenor)
River Channel Forms and Dynamics	yr 2	Option Module (Convenor)
River Channel Dynamics	yr 2	Option Module (Convenor)
River Channel Management & Restoration	yr 3/MSc	Option Module (Convenor)
Environmental Management in Practice	MSc/MA	Core Module (Contributor)
Foundations of Environmental Management	MSc/MA	Core Module (Contributor)
Professional GIS	MSc	Core Module (Contributor)

East Midlands Consortium	Mphil/PhD	Research Training (Contributor)

CURRENT DOCTORAL SUPERVISION

Student	**Topic**
Liphapang Khaba	Modelling Soil Erosion and Sediment Transport for the Nqoe River Catchment, Lesotho (International Studentship)
Shaun Maskrey	Networks of Influence: Improving the Evaluation of Innovative Flood-Risk Solutions (EPSRC Studentship)
Tim Meadows	Landscape Evolution Modeling at Mount St Helens (Nottingham University Studentship)
Oladipo Olafino	Impact of the Floods and Water Act (2010) on Future FRM in the UK (self-funded)
Georgina Wood	Water Literacy, citizenship and sustainable schools strategy: transition education for environmental sustainability (ESRC Studentship)
Liam Clark	Measuring and Evaluating River width using Remote-sensing (University Studentship)

PAST DOCTORAL SUPERVISION

40 PhDs supervised to successful completion, to date.

CURRENT ADMINISTRATIVE DUTIES

2009- Undergraduate Admissions Tutor responsible for:

UCAS Code	**Degree Title and Intake**
F800	BSc Geography (79)
F630	BSc Environmental Geoscience (20)
L700	BA Geography (79)
L7N1	BA Geography with Business (21)
L7T1	BA Geography with Chinese Studies (9)

PAST ADMINISTRATIVE DUTIES

Dates	**Position**
1993-96	Head of Department, Department of Geography, University of Nottingham.
1998-2001	Dean, Faculty of Law and Social Sciences, University of Nottingham.
2011-12	Deputy Head, School of Geography, University of Nottingham

PAST PROFESSIONAL COMMITTEES

Journal of Geography in Higher Education: Editorial Board 1990-1993

British Geomorphological Research Group: Executive Committee Member 1989-92

Earth Surface Processes and Landforms: Guest Editor ‘Geomorphology at Work’ Edition, 1995

American Society of Civil Engineers: Chair, Task Committee on Hydraulics, Soil Mechanics and Modelling of River Width Adjustment 1993-1998

Earth Surface Processes and Landforms: Guest Editor, IAG Special Edition 1999

British Geomorphological Research Group: Awards Committee 2001-2004

Geomorphology: Member of Editorial Panel 1992-2010

CERTIFICATION

I have the honour to certify that the documents annexed to this Counter-memorial are true copies and conform to the original documents and that the translations into English made by Costa Rica are accurate translations.

Jorge Urbina

Co-Agent of Costa Rica

LIST OF ANNEXES

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