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

(NICARAGUA V. COSTA RICA)

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Environmental Impacts of Juan Rafael Mora Porras Route 1856,
Costa Rica, on the Río San Juan, Nicaragua

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Berkeley, California USA

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1. INTRODUCTION AND SUMMARY

1.1 Introduction

The Río San Juan drains from the outlet of Lake Nicaragua, dropping 33m as it flows 200 km to the Caribbean. The lower 130 km of the Río San Juan form the border between Nicaragua and Costa Rica, with the border itself following the south (Costa Rican bank) of the river, rather than the center line. Since 2011, Costa Rica has been constructing a road along the border, downstream to the Río Colorado bifurcation, designated as the Juan Rafael Mora Porras Route 1856 (Route 1856).

This report analyzes the length of Route 1856 where it follows the Río San Juan (i.e., where the river bank forms the Costa Rican border, approximately 10km downstream of El Castillo) down to the Río Colorado bifurcation in the Delta. The objectives of this study were:

1. To assess the environmental impacts of the road and its construction, based on prior scientific literature, decades of field experience working on road-related erosion impacts, site-specific observations from a river boat and a helicopter overflight, and from analysis of aerial photography, satellite imagery, and topographic maps; and

2. To identify measures needed to address serious problems of slope instability and soil erosion that are adversely affecting the Río San Juan and Nicaragua.

1.2 Author Biographies

G. Mathias (Matt) Kondolf is a fluvial geomorphologist and environmental planner, specializing in environmental river management and restoration. He is Professor of Environmental Planning at the University of California, Berkeley, where he teaches courses in hydrology, river restoration, environmental science, and Mediterranean-climate landscapes, and serves as Chair of the Department of Landscape Architecture and Environmental Planning. He is a recognized expert on human-river interactions broadly, with emphasis on the management of flood-prone lands, sediment management in reservoirs and regulated river channels, and river restoration. He co-edited the reference work on methods in the field, *Tools in Fluvial Geomorphology* (John Wiley & Sons 2003, 2nd edition forthcoming in 2013). He recently served as the Clarke Scholar at the Institute for Water Resources of the U.S. Army Corps of Engineers in Washington, D.C., and formerly served on the Environmental Advisory Board to the Chief of the Corps and on the Science Board for the CALFED Ecosystem Restoration Program. Professor Kondolf lectures and conducts research on river geomorphology, management, and restoration in the United States and abroad. He has provided expert testimony on river-related issues to the U.S. Congress, the California Legislature, the California Water Resources Control Board, and in various legal proceedings. He received his AB in Geology (*cum laude*) from Princeton University, a masters in Earth Sciences from University of California, Santa Cruz, and a PhD in Geography and Environmental Engineering from the Johns Hopkins University.

Danny K. Hagans is principal geologist and co-owner of Pacific Watershed Associates (PWA), a professional geological consulting firm headquartered in northern California. He has a Bachelors degree in Geology from Humboldt State University (Arcata, California) and has worked as a geologist for the U.S. Forest Service, the U.S. National Park Service and, since 1990, as owner and Principal Geologist for Pacific Watershed Associates. Mr. Hagans is a Certified Erosion and Sediment Control Specialist and a member of various professional geological organizations. He has extensive experience and specializes in conducting and managing large-scale, basin-wide erosion inventories and sediment assessments, as well as implementing watershed rehabilitation and restoration projects in the western United States. He has 12 years professional experience as a National Park Service geologist at Redwood National Park, California, during which he conducted steepland erosion research, conducted technical reviews of proposed timber harvesting and road construction proposals, and worked on the development and implementation of the park's internationally recognized watershed rehabilitation program for the 725 km^2 Redwood Creek watershed. Mr. Hagans is considered a leading national expert on the role of forest land use and road construction on erosion and sedimentation, and on the preparation and implementation of watershed-wide erosion and sediment control plans for road systems in the steep forested watersheds of the Pacific Northwest. He has co-authored a number of publications on the assessment of logging and road construction on watershed erosion processes, and the development and implementation of restoration plans for sediment impaired watersheds. Mr. Hagans has conducted literally hundreds of technical trainings and workshops on erosion and sediment control, specifically focused on public and private road systems. He has co-authored books and publications including the *Handbook for Forest and Ranch Roads*, a technical field guide for road planning, design and construction, as well as *Upslope Erosion Inventory and Sediment Control Guidance; Storm-proofing Forest Roads; Sediment Treatments and Road Restoration;* and *Road Upgrading, Decommissioning and Maintenance - Estimating Costs on Small and Large Scales*, among others.

William E. Weaver is principal geomorphologist and co-owner of Pacific Watershed Associates (PWA), a professional geological consulting firm in northern California. He has a Bachelors degree in Geology from the University of Washington (Seattle) and a PhD in Geomorphology (Earth Resources) from Colorado State University (Fort Collins). From 1976 to 1989 he served as the lead Engineering Geologist for the U.S. National Park Service, Redwood National Park, and then as owner, CEO and Principal Geomorphologist for PWA. Dr. Weaver is an Adjunct Professor of Geology at Humboldt State University (Arcata, California) and has served on various Advisory Panels for the state of California regarding forest practices and road construction impacts, and best management practices to protect water quality. As the principal Engineering Geologist at Redwood National Park for 13 years, Dr. Weaver was instrumental in designing, initiating, and monitoring the internationally recognized watershed rehabilitation and erosion control program covering the park and the 280-square mile

Redwood Creek watershed. Most recently his work has concentrated on sediment source investigations and road-related sediment control projects throughout the Pacific Northwest. Dr. Weaver is considered a leading national expert in the field of steepland erosion processes, the impacts of road construction, the effects of land management on watershed sediment yield, and the design and control of road-related erosion processes in steep, forested environments. Dr. Weaver has conducted literally hundreds of technical trainings and workshops on erosion and sediment control, specifically focused on public and private road systems. He has co-authored books and publications including the *Handbook for Forest and Ranch Roads*, a technical field guide for road planning, design and construction, as well as *Upslope Erosion Inventory and Sediment Control Guidance; Storm-proofing Forest Roads; Sediment Treatments and Road Restoration;* and *Road Upgrading, Decommissioning and Maintenance - Estimating Costs on Small and Large Scales*, among others.

Eileen M. Weppner is a geologist specializing in watershed erosion assessments, sediment budget studies, development of erosion and sediment control plans for steepland road systems, and the implementation of road-related erosion and sediment control projects. She is a senior geomorphologist and Watershed Division Manager at Pacific Watershed Associates (PWA), a professional geological consulting firm headquartered in northern California. She has a Bachelors degree in Geology from the State University of New York at Buffalo, and a pending Masters Degree from Humboldt State University (Arcata, California). She is a California Professional (licensed) Geologist and a registered geologist in Oregon and Washington. Ms. Weppner has been a lead geologist for the Watershed Assessment and Restoration Division of PWA since 2000. She is considered a leading regional expert in the assessment of road-related erosion problems, development of erosion control and erosion prevention plans, and the implementation of large-scale sediment control projects for road systems in steep forested watersheds. Ms. Weppner's professional experience includes extensive work on watershed analyses and Total Maximum Daily Load (TMDL) studies for the U.S. Environmental Protection Agency (EPA) in a number of large California watersheds. Her publications include co-authorship of *Upslope Erosion Inventory and Sediment Control Guidance,* the official state-adopted protocols for assessing and controlling road-related erosion in forested watersheds of California.

1.3 Summary

1.3.1.Methods

We analyzed high-resolution satellite imagery to map the footprint of Route 1856 for the 108 km that it follows Río San Juan, and the extent of disturbance from the road and attendant quarries and related disturbances. In October 2012, we conducted reconnaissance by both helicopter and riverboat, noting and photographing features along the road, including evidence of slope instability and erosion.

From the riverboat, we also examined sites of road construction through sloping land visible from the river, noting approximate size and condition of road fills, while estimating approximate percentages or volumes eroded to date. We identified locations where sediment has been delivered into the Río San Juan from the southern bank, such as from gullies carved by concentrated road runoff, as well as landslides in unstable road cuts and poorly constructed road fills along the newly built road. We sampled sediment from debris cones and other marginal sediment deposits in the channel of Río San Juan, all clearly derived from road-induced erosion.

We estimated erosion from areas disturbed by the road construction, including exposed bare soil on unpaved sections of road and other cleared areas such as quarries, using chronic erosion rates published in the scientific literature. We also estimated potential sediment delivery from mass wasting by taking the total area that has been cleared or disturbed, subtracting the 7-m road width, and then assuming, based on our *in situ* observations, that 40-50% of the disturbed cut- and fill-slopes has been affected by gullies or landslides.

1.3.2 Environmental Effects of Road Construction

Roads disturb pre-existing natural drainage patterns, increasing storm runoff from a given rainfall, and more importantly, concentrating surface runoff such that it is capable of eroding gullies and transporting sediment and contaminants to surrounding river systems. Roads cutting across steep hillslopes concentrate runoff even more by virtue of the steep slopes. If runoff down roads and adjacent ditches is not diverted and spread to infiltrate into the soil and groundwater, the effect of gullying and road surface erosion is exaggerated because of the steep topography. The cut and fill required to put the road across a slope also has the potential to induce the landslide failure of the cut banks and failure of fill prisms. In essence, the entire volume of material moved to make the road becomes vulnerable to mass wasting and particulate erosion. As a result of these multiple effects, road-related sediment can dominate the sediment budget in river systems located near such roads (Reid and Dunne 2003). The increased sediment loads to rivers are documented to have caused degraded water quality, as well as the loss of aquatic vegetation, macroinvertebrates, amphibians, and valued fish species. These effects have been documented in multiple sites around the globe in a wide range of ecosystems.

1.3.3 Location and Characteristics of the Road

While some of Route 1856 has been constructed on pre-existing local roads, more than half is completely new construction, much of it on steep terrain. A comparison of the 2012 footprint of Route 1856 with 2009 pre-construction satellite imagery of the same location indicates that 56.3 km (52%) of the road is completely new construction. Even where Route 1856 follows sections of pre-existing road, it has a significantly larger footprint, and therefore creates significantly more impermeable surface. Of the 56.3 km of Route 1856 that is new construction, 24.6 km is located on steep terrain, much of which used to be densely forested. Within the 41.6 km of the road upstream of the Río San Carlos – the section of Route 1856 that traverses the steepest topography and is 86% new construction – there was a total of 99.8 ha of disturbed land, of which 41.6 ha involved the removal of previously undisturbed forest. Over 30 km of Route 1856 has been built across steep hillslopes, many composed of deeply weathered, unconsolidated, or otherwise weak material, which is prone to erosion and slope failure.

A large portion of Route 1856 encroaches into the 50-m setback from the bank of the Río San Juan specified by Costa Rican law, with the road coming within approximately 5 m of the river bank at a number of locations. The section of the road above Río San Carlos has the highest rate of setback violation, with 30 % of that stretch located within 50 m of the river bank. 100 m is a more reasonable buffer to prevent the transport of sediments to the Río San Juan. Nearly half of the road is located within 100 m of the river bank, creating a high likelihood that sediment eroded from the road will enter the river.

The poor siting of Route 1856 – across steep, unstable hillslopes and in close proximity to the river – was a serious error with significant short- and long-term environmental consequences. There is no technical or environmental reason that the road needed to go where it was put. In fact, the contrary would be true: better sites with more stable ground, located a greater distance from the river, would have resulted in far less environmental impact, and over the long run, far less expense in attempting to maintain a poorly-sited, poorly-constructed road.

1.3.4 Construction Errors and Violations of Best Management Practices

The problem of the erodibility of the steep new slopes located unreasonably close to the Río San Juan are exacerbated by the additional poor practices that were employed during and after the construction of Route 1856, which occurred without plans and without the benefit of an environmental impact analysis.

Our aerial and riverboat reconnaissance, analysis of aerial imagery, and the reports and images presented by CFIA (2012) and LANAMME (2012) make plain that the construction of Route 1856 has involved excessive and disorganized earthmoving works. There are many places along Route 1856 where it is obvious that the construction crew began to put the road along one route, only to abandon the partially completed route and build the road elsewhere, effectively doubling the impact of the road.

Construction of Route 1856 has left large areas of exposed soil, disrupted hillslope topography, steep cutbanks, and mounds of loose, unengineered (uncompacted) fill. We observed numerous examples of steep cutbanks that have already failed, both along the road itself and in nearby rock quarries. Along most of the road, fill materials were clearly sidecast downslope, i.e., pushed to the edge of the road and allowed to fall down the slope. We observed few newly constructed fillslopes that did *not* clearly exhibit widespread settlement, slope failure and mass movement of material following construction. Several fillslopes appeared to have large pieces of dead wood incorporated into them. These construction methods – sidecasting, lack of compaction, and incorporation of woody debris in fill materials – are a recipe for continued slope failure and off-site sediment delivery.

From our field inspection (from aerial overflight and from riverboat inspections) of approximately 60 recently constructed stream crossings, we observed that essentially all road-stream crossings exhibited some form of serious design and/or construction deficiency, which will likely lead to failure during future intense rains. At virtually all the observed stream crossings, some volume of sediment has been introduced directly to the receiving tributary stream and to the Río San Juan during construction of the crossing. More importantly, most road-stream crossings along the newly built road pose a moderate to high risk of future failure because they are significantly undersized or they were poorly constructed.

Erosion potential is a function not only of the extent and nature of exposed earth, but also of the intensity of expected rainfall. In this tropical region, rainfall intensities can be very high, especially during tropical storms and hurricanes. In the two years since construction began, rainfall has been relatively modest, so the disturbed road surfaces and attendant works have not yet been put to a real test. The extensive disturbance caused by the sloppy construction of Route 1856 has set the stage for significant damage during the next hurricane to hit the region.

A construction project of this sort should be protected from rain impact and landsliding through the use of erosion control and slope stabilization measures. To prevent the washing away of exposed earth, it is standard procedure to cover exposed areas with mulch, vegetative cover, or geotextile substitutes. However, most of the bare exposed ground surfaces of Route 1856 have not been protected in any way, and where geotextiles have been installed, they have mostly failed.

Route 1856 has long lengths of road surfaces that drain to inboard ditches, which yield concentrated runoff. Not only is the runoff from a given rainfall increased because the compacted road surface does not infiltrate, but the runoff is collected and concentrated such that road surface and ditch erosion is virtually guaranteed to occur. Where these concentrated flows are discharged onto adjacent fills and native slopes, severe gullying results. The lack of adequate road surface drainage structures along Route 1856 is reflected in the consequent widespread and serious gully erosion already taking place, which efficiently delivers eroded sediment directly to the Río San Juan. This problem is compounded by the unnatural concentrations of water resulting from the disruption of natural surface and groundwater flow paths, which can reduce slope stability and trigger landslides and debris flows.

The lack of proper drainage has resulted not only in erosion and gullying of the road works and attendant features, but also to substantial "hydrologic connectivity" between the road and the many watercourses in the project area, including the Río San Juan and many of its tributaries, which are receiving improperly drained, sediment-laden runoff from Route 1856.

By way of comparison, all of these construction practices were commonplace in the Pacific Northwest of North America in the 1950s and 1960s, and they created a legacy of problems that persist to this day, including continued slope instability in many sites, excessive sediment supply persisting in many rivers such that aquatic habitats are still degraded and cannot support fish and other species as they once did, as well as damaged fish populations that have never recovered their pre-disturbance levels. As a result, these destructive road-building practices are now prohibited by law in much of the United States.

1.3.5 Road-Derived Sediment Pathways to Río San Juan

Sediment eroded from Route 1856 has already reached the Río San Juan through a number of pathways. These include shallow failures of sidecast fill material on sections of road located on hillslopes directly adjacent to the river channel, and erosion and mass wasting of the massive, un-engineered road-fill prisms. Concentrated road runoff has carved substantial gullies through these earthen fills, and shallow slumps are also commonly observed; many of these features are directly connected to the Río San Juan.

We observed direct evidence that sediment from gullies in earthen road fill has been delivered to the Río San Juan, including over 50 stream/gully input points where we documented road-derived sediments that had been deposited in fans, mud, and other materials in the river. In some locations, we documented a trail of angular sand and gravel across an alluvial flat to finally discharge into the river, where we could find its deposited cone of similar-sized (and finer) sediment underwater, projecting from the bankline. Numerous slumps have developed on these road fills, but the failed material had not always yet reached the river. The earthen fills are extensively rilled and gullied, and much of the material eroded from these fills enters the river system at stream crossings located along the road. Similarly, sediment eroded from the road surface enters the stream system at road crossings; these are the lowest points in the road system, so roads drain towards them, carrying eroded sediment into the tributary, and ultimately into the Río San Juan.

1.3.6 Estimated Ongoing Sediment Contribution

There are two main ways that Route 1856 produces sediment that gets into the river: from chronic erosion of soil particles transported by water; and from mass wasting, whose products can be transported to the river directly by mass soil movement or by flowing water. Measured erosion rates commonly exceed rates of sediment delivery to rivers, because some sediment is stored (at least temporarily) in sites between the point of erosion and the river. Thus, in addition to estimating the volume of sediment eroded at the road itself, it is important to identify potential routes by which sediment can be transported to the river. In our field work, we documented direct delivery of sediment from road erosion to the river at 54 sites along the road.

Our estimate of surface erosion rates for the upstream 41 km of Route 1856, upstream of Río San Carlos, indicates that surface erosion is producing 17,800 to 21,300 cubic meters of sediment per year. For the 41-km section of road upstream of the Río San Carlos confluence, we estimated 218,400 to 273,000 cubic meters of sediment eroded by mass wasting and gullying per year, roughly ten times the amount estimated for surface road erosion. We estimate that 40% of all of this sediment is reaching the Río San Juan, implying an annual and ongoing sediment input of 87,000 to 109,000 cubic meters. Future erosion and sediment delivery during a tropical storm or hurricane will likely be greater than the current sediment transfer by a factor of at least ten.

2. <u>METHODS</u>

2.1 Characterization of Hydrologic Setting and Literature Review

We reviewed relevant available information on rainfall, runoff, and sediment loads to provide a context for specific observations on the roads. We reviewed relevant scientific literature on the hydrological and environmental impacts of road construction generally, and empirical studies of road impacts undertaken in the humid tropics.

2.2 Analysis from aerial imagery

We reviewed numerous potential sources of satellite imagery. To provide a basis for measuring change due to construction of Route 1856, we sought high quality imagery for current conditions and for conditions immediately prior to construction of the road. We ultimately obtained (from a commercial source, Spatial Solutions of Bend, Oregon USA) 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.

Given that the region is cloudy much of the time, we searched for suitably cloud-free imagery to provide a clear view of the road corridor and river bank. In addition, we reviewed existing topographic maps and other aerial imagery.

Using this imagery, we used ArcMap GIS to digitize the entire length of Route 1856 from the international border (13 km east-southeast of El Castillo) downstream along the south bank of the river to the staging area near the point where the Río Colorado splits off from the Río San Juan. On our digital representation, we recorded whether the road was situated on gentle/flat slopes or steeper slopes. Steep areas were determined by evident topography and the presence of large, bare cutslopes. Areas of gentle topography were those displaying little relief and few cuts, typically on river terrace or alluvial flats. We also documented whether the road was native surface or rock surfaced. Using the 2009 imagery as the pre-road baseline against which to map road-induced changes, we:

1. Documented the extent, condition and location of pre-existing road segments (prior to construction of Route 1856);

2. Overlaid the footprint of pre-existing and newly constructed road along the alignment; and

3. Evaluated the distribution of road segments found on flat and steep terrain, the latter with a higher risk of erosion and sediment delivery to the river.

We scaled a 50-m buffer in GIS around the river's right bank to determine the length of road that lies within the 50-m designation for "Agricultural Property of the State" as defined in Article 7 of the Lands and Colonization Law of Costa Rica, and the protected zone of 50 m from a stream bank as specified for "uneven" land by Costa Rican Forest Law No.7575 Art.33 Sec.ii. In addition, we also scaled a 100-m buffer to identify sections of road that were so close as to be likely to deliver eroded sediment to the river.

We also identified locations where the road crossed streams based on appearance of stream channels on the 2009 and 2012 orthophotography, 1:50,000 topographic maps, October 2012 field reconnaissance maps, our field notes and photography, as well as photography provided in prior reports.

2.3 Aerial Overflight Observations

We conducted aerial reconnaissance from a helicopter (flying at an elevation of approximately 300 m above sea level) along the entire length of road adjacent to the Río San Juan, passing once in the downstream direction, and a second time in the upstream direction, taking notes and photographs. The flight paths were solely within Nicaraguan air space. On each pass, we documented existing road construction practices, design standards and erosional conditions along the route through still photographs and the hand mapping of road segments on topographic maps, in order to document the current status of road construction, selected erosion features and the proximity of the newly pioneered road to the Río San Juan. As a part of the assessment, we identified road reaches that either have already delivered eroded sediment to the river, or that pose a moderate to substantial risk of future sediment delivery to the Río San Juan.

2.4 Field Observations/Measurements from River

In October 2012, we conducted two days of reconnaissance from the river, inspecting the road where it runs adjacent to the river. In particular, from a riverboat, we examined road construction sites cutting through sloping land that was visible from the river, noting approximate size and condition of road fills and estimating approximate percentages or volumes eroded to date. We identified numerous sediment delivery locations from the south bank of the Río San Juan, including gullies carved by concentrated road runoff and landslides in unstable road cuts and poorly constructed road fills along the newly built road. We recorded on topographic maps the most problematic sections of road to identify road reaches that have already delivered sediment to the Río San Juan or pose a high risk of future sediment delivery.

We documented pathways of sediment visible from eroding sites to the river channel, and we further documented details of such well-connected sediment sources. We examined each tributary confluence for evidence of sediment delivery (limited by water depth and turbidity at confluences). We consulted map, aerial imagery (when available), and notes from the aerial overflight to assess the size of the contributing catchment. Remaining within Nicaraguan waters, we sampled sediment from debris cones and fine sediment deposits in the channel of the Río San Juan, all clearly derived from road-induced erosion, along a 17-km length of river between km 0.75 near Finca Chicochele and km 17.95 located just downstream from Las Crucitas and the Cano Crucitas (see Appendix D for grain size data from samples and sample locations).

2.5 Estimates of Erosion and Sediment Delivery from Areas of Exposed Soil

We estimated the volume of erosion from areas disturbed by the road construction, including exposed bare soil on unpaved sections of road and other cleared areas such as quarries, using chronic erosion rates published in the scientific literature. In GIS, we first buffered the road to create a polygon layer and edited to incorporate all bare soil areas, including the road alignment, cutslopes, and fill prisms where visible. This bare soil polygon layer included all of the road attributes discussed above to facilitate analysis and was used to calculate the total bare soil area, according to road surface type and slope location. From our aerial analysis, we distinguished four categories of road based on topography (steep/gentle) and whether the road surface was “rocked” or “native surface.” Due to time constraints, we completed this analysis only for the upstream 41 km of the road, upstream from the Río San Carlos confluence. We treated this section with priority because it has the steepest topography overall. We drew upon published studies of road surface erosion rates in tropical areas and in the Pacific Northwest of North America where logging roads formerly were constructed using precisely the same practices utilized in the construction of Route 1856 (Sidle et al., 2004; Douglas, 2003; Washington DNR, 2011), in order to estimate road erosion rates from the following four categories of road surface to yield volume estimates of surface erosion in cubic meters and tonnes: 1) Rocked surface/Gentle slope; 2) Rocked surface/Steep slope; 3) Native surface/Gentle slope; and 4) Native surface/Steep slope. Chronic road surface erosion can be an important component in the sediment budget, especially as it produces suspended sediment-laden runoff from even small rainstorms, which would not otherwise produce muddy runoff.

In terms of overall annual contributions to the sediment budget for roads crossing steep terrain, surface erosion is typically dwarfed by mass wasting (Reid and Dunne 2003). We, therefore, also estimated the volume of sediment delivery from mass wasting. To calculate that volume, during our field reconnaissance we documented significant slope failures such as landslides and slumps that have already occurred at several sites, also estimating the percentage of the total fill volumes that had failed. Many more show clear signs of pending failure and will likely fail in a future storm event. Using these observed rates, we estimated potential sediment delivery from mass wasting by taking the total area that has been cleared or disturbed, subtracting the 7-m road width, and then assuming, based on our *in situ* observations, that 40-50% of the disturbed cut- and fill-slopes has been affected by gullies or landslides.

3. RESULTS: LITERATURE REVIEW AND LAND DISTURBANCE

3.1 Environmental Effects of Road Construction

Constructing a road such as this has well-documented environmental effects, especially where roads are constructed in steep terrain and through weak geological materials (e.g., Ziegler and Giambelluca 1997, Spinelli and Marchi 1996, Douglas 1976, 2003).

3.1.1 Hydrologic Impacts

Constructing a road across formerly natural or agricultural land will convert formerly pervious surface into impervious surface. Falling rain can no longer infiltrate into the soil and groundwater, but flows on the compacted road as surface runoff. Moreover, by virtue of its linear nature (and depending on how the road is graded), the road tends to channel surface runoff, often in a ditch adjacent to the road surface. Thus roads produce concentrated surface runoff, not only because of the lack of infiltration on the road surface, but also because they collect dispersed runoff into concentrated flow. The longer the distance that surface runoff travels along or across the road, the more water accumulates, the deeper the flow becomes, and the more it can erode the road surface itself and the fillslopes over which it is drained, creating gullies. When eventually discharged from the road, the concentrated runoff has a high erosive potential, and is capable of rapidly eroding gullies in the hillslopes below the road. Unpaved roads are prone to high, chronic erosion from surface runoff, and the concentrated surface runoff from the road can cause gullies and other downstream impacts in virtually any topographic setting. As a general rule, the more traffic on an unpaved road, the more chronic erosion will occur. Paving such roads normally reduces chronic erosion (provided the road is otherwise well-constructed) on the road surface, but the bare fillslopes, cutslopes and unpaved turnouts are still sources of runoff and chronic surface erosion. Concentrations of surface water can also result in concentrated infiltration into parts of the hillslope that were not naturally subject to so much water, creating elevated pore pressures and increasing the potential for slope instability and landsliding.

3.1.2 Cut and Fill Slopes

Where roads are constructed across steep hillslopes, another set of problems ensues. The typical construction method is “cut and fill,” whereby heavy equipment is used to excavate the hillside on the upslope side of the road, creating a flat road surface adjacent to a now-steeper slope (the “cutslope”) (Figure 1A, 1B). The material that is removed is placed on the downslope side so that it forms the outer part of the road (the “fill prism” or “fill slope”). The cut-and-fill interrupts the flow paths of shallow groundwater, which causes the groundwater to seep out of the cutbank.

The stability of the cutslope depends on the nature of the geologic material into which it is cut (e.g., whether it is competent bedrock or weak material, be it from inherently weak rock type or deep weathering; the orientation of bedding planes if any; and the degree of fracturing of the material). Cutting into and removing rock and soil materials removes lateral support for the upslope hillside. Cutslope stability can also be compromised by the positive pore pressure produced by flowing and emerging groundwater, which can cause failure of the cutbank, sometimes by small chunks breaking off, and sometimes in the form of larger, deep-seated slides. The movement of large blocks of soil and rock under the influence of gravity (as opposed to being transported in water) is termed “mass movement” or “mass wasting.” Such mass movements or landslides are possible in the cutbank, in the fill prism, and in the underlying slope below (Figure 1C).

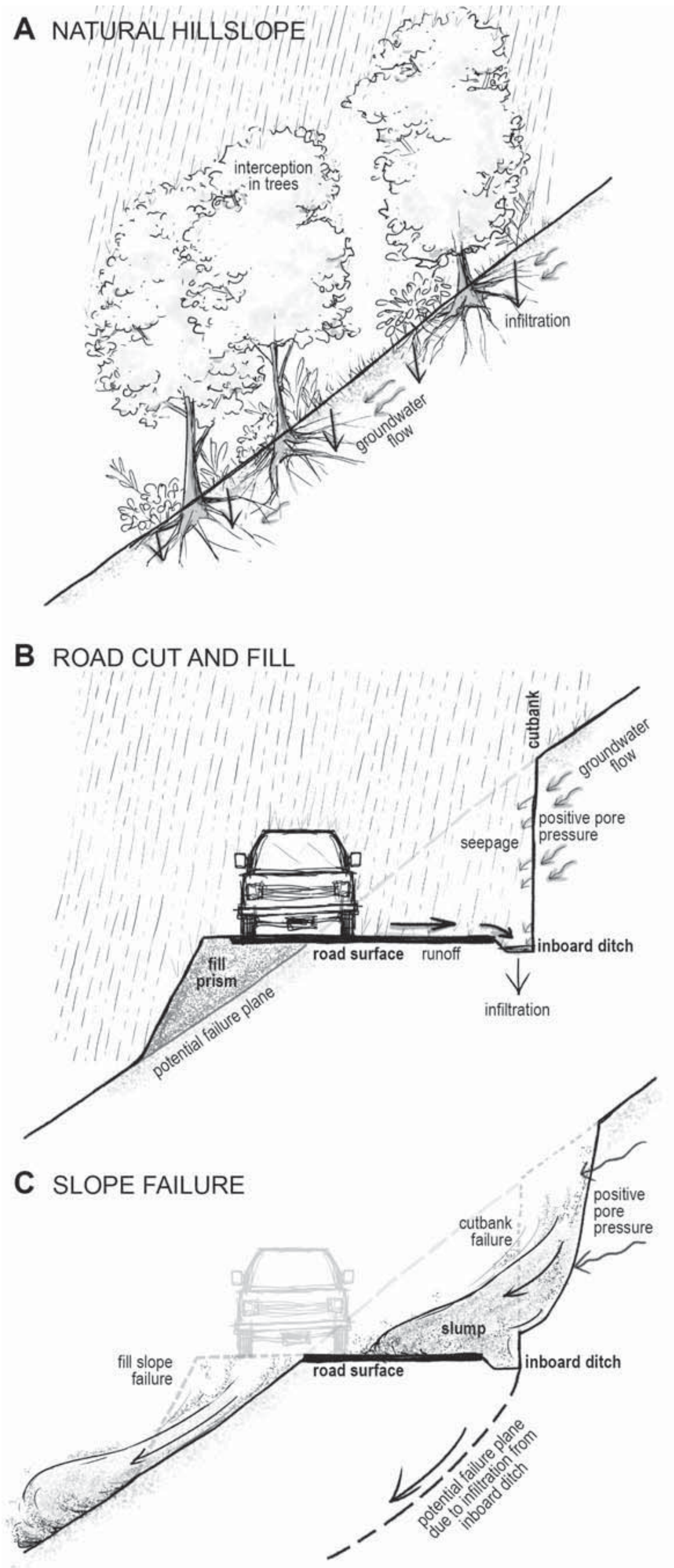
The stability of the fill prism depends largely on how it is constructed. If the underlying slope has been properly cleaned and the fill compacted to engineering standards, it may be stable for years or decades. (Because it is a mass of sediment perched on a slope, it is vulnerable to gravity, and thus to mass wasting, eventually.) If the underlying slope is not cleared and scarified (prepared) before placing fill, and if the fill is not compacted to engineering standards, the fill prism will be highly unstable. “Side casting” refers to the bulldozer blade simply pushing material (removed from the cutbank) “over the edge” so that it tumbles down the bank. Such sidecast fill is prone to failure as a mass movement, often failing along the former (buried) ground surface, or partial failure of sediment within the fill prism. If the fill prism includes dead trees and other such debris, either because the underlying slope was not properly cleared or such debris was incorporated in the cutting of the bank, the likelihood of failure is increased. Failure of such poorly constructed fill prisms was one of the principal sources of the high sediment loads entering rivers of the Pacific Northwest of the United States during the 1940s–1960s. Where heavy fillslopes now crush and block subsoil drainage pores, or where water collects in the inboard ditch (commonly due to debris clogging drain structures) and induces concentrated infiltration of water into the subsurface, elevated pore pressures can result, and deeper-seated landslides can be induced and triggered (Figure 1). Changes in mass balance on the surface of the hillslope, as well as changes in subsurface flow paths and pore pressures, can trigger both slope stability problems and mass soil movement.

<u>Figure 1.</u> Diagram showing cut-fill construction sequence and consequences (drawing prepared by Jennifer Natali from draft by Matt Kondolf).

A. Natural, forested hillslope, on which most rainfall is intercepted by plant leaves or infiltrates into the soil to recharge groundwater, and supporting shallow groundwater draining downslope. Tree roots help to stabilize the soil.

B. To build a road across the slope usually involves cut and fill: cutting a steeper slope in the hillside to create a flat surface, and using removed material to build out the road, over a fill prism. The cut has interrupted the downslope flow of shallow groundwater, so water seeps from the cutbank. The road surface concentrates runoff, which collects in the inboard ditch, where concentrated water can infiltrate.

C. The downslope-flowing water creates a positive pore pressure behind the cutslope, which in effect pushes out chunks of earth and induces landslides. Concentrated infiltration of water along the inboard ditch can increase saturation and pore pressure along potential failure planes in the hillslope. The fill prism is inherently unstable by virtue of its location perched on the slope. These fills commonly fail along the former ground surface beneath the fill (a potential failure plane).



3.1.3 Stream Crossings

Among the most critical points in road design and planning are stream crossings. Bridges large enough to pass large floods (typically the 100-year flood) are the best way to cross, as they do not limit the flow of water, and if designed to be high and with long clear spans (i.e., no bridge piers or wide openings between bridge piers) they are unlikely to trap debris. However, bridges are expensive, so cheaper options are often used, such as earthen fill crossings with culverts (Figures 2, 3). These are inherently unstable features, because they involve placement of massive volumes of fill within the stream channel and valley, where it can easily be eroded and enter the river system, and depend on the culvert to successfully pass all flood flows through a constricting pipe. To build such crossings well, the culvert should be constructed of strong material, either concrete pipe or box culvert, or corrugated steel conduit, and should be sized to pass a large design flow, usually specified at 50 or 100 years recurrence interval flood discharge. To prevent debris (such as trees and logs) from being caught at the culvert entrance, trash racks are installed upstream to intercept large debris before it plugs the inlet and causes the crossing to "wash out" and fail. The earthen fill material in the crossing should be compacted to engineering standards so that it can bear the weight of the anticipated traffic and should be designed so that in the event the culvert plugs, water upstream has a path by which to overflow the road and return flow to the same stream channel without diverting down the road or washing out the earthen fill of the crossing.

Undersized culverts (culverts whose openings are smaller than a suitable design flow) will back up water during floods, are more likely to be blocked by debris, and thus pose a greater threat of washing out the entire earthen fill during high flows. Culverts constructed of weak materials may collapse under the weight of the fill and truck traffic, blocking drainage and damaging the functioning of the road crossing. Common design standards require the culvert to be installed on the original streambed, aligned with the natural stream channel above and below the crossing site, be sized to accommodate the design flood flow (preferably the 100-year flood discharge), have a fill that is properly compacted to engineering standards with stable 2:1 upstream and downstream fillslopes, and have a low point or dip places on or near the fill's left or right hinge line to prevent stream flow from being diverted down the road in the event of overtopping.

Figure 2. Earthen-fill road crossings are created by installing a box culvert or pipe along the bed of the stream or swale, and filling with earth, then siting the road on top of the fill (drawing prepared by Jennifer Natali from draft by Matt Kondolf). While less expensive than bridges, earthen crossings are prone to erosion and/or failure of the earthen fill, or culvert blocking and washout of the earthen fill, which contributes sediment directly to the stream. Common design standards require the culvert to be installed on the original streambed, aligned with the natural stream channel above and below the crossing site, be sized to accommodate the design flood flow (preferrably the 100-yr flood discharge), have a fill that is properly compacted to engineering standards (with stable 2:1 upstream and downstream fillslopes), and have a low point or dip placed on or near the fill's left or right hinge line to prevent stream flow from being diverted down the road in the event of overtopping. By contrast, the earthen-fill crossings on Route 1856 appear to have uncompacted and over-steep fillslopes and substandard culverts. Some appear to be undersized and many consist of substandard materials that will fail.

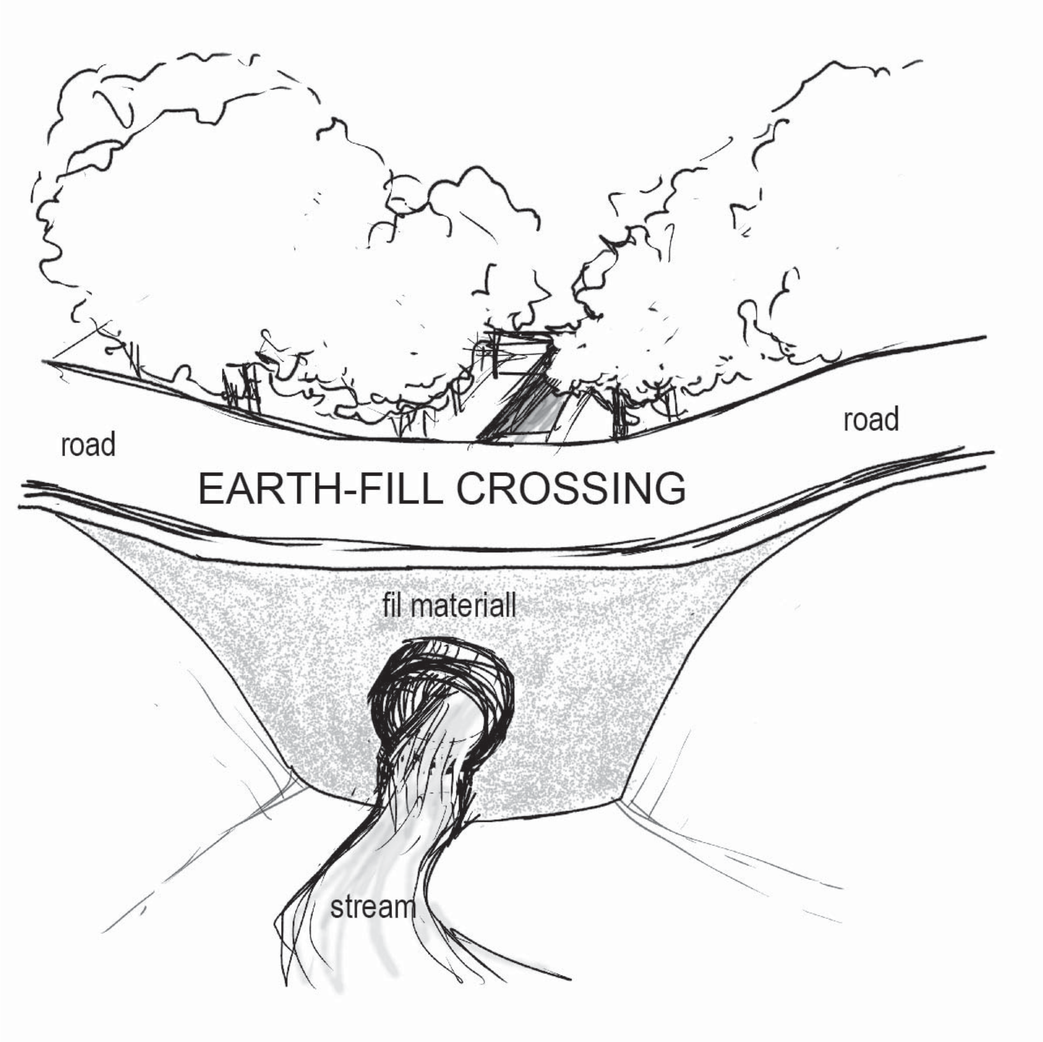


Figure 3. Photo #78a at km 18.25 from upstream end of Route 1856 along border. Large fill volume at culverted stream crossing with very poorly constructed fills at the crossing and along the approaches. Culvert is positioned high in the fill and likely not sized for the 100-year discharge.

3.1.4 Ecological Impacts

The combination of the hydrologic changes and increased erosion and sedimentation that result from road construction results in significant increases of sediment loading to rivers and streams, which in turn, have been documented to cause a range of serious environmental problems (e.g., Wood and Armitage 1997). To understand these problems, it is useful to distinguish between coarse sediment (i.e., gravel and sand) and fine sediment (silt, clay and sand, which is intermediate in its properties), because they move through the environment and usually affect river stability, ecosystems, and water quality differently. Increased delivery of coarse sediment to rivers can result in significant changes to river processes, causing aggradation (increase in land elevation from sediment) of the river channel with consequent loss of channel capacity, increased flood risk to settled areas, threats to infrastructure such as bridges downstream, and channel destabilization as flow is displaced from sediment-choked channels towards the banks. Aggradation also results in the burial of important aquatic habitats and consequent loss of native species, impacts that have been documented to persist for decades (USDA Forest Service 1999, Ziemer and Lisle 1992, Madej and Ozaki 2009).

The contribution of large volumes of fine sediment into rivers is known to result in increased turbidity, reduced light penetration, and consequently, reduced primary productivity, which can have effects up the food chain; loss of periphyton and consequent impact on the food chain; clogging and damage to gills of fish from high concentrations of suspended sediment; infiltration of fine sediments into formerly clean gravel substrate needed by aquatic macroinvertebrates, juvenile fish, and other organisms as habitat; loss or reduction of macroinvertebrate populations; reduced exchange of stream and shallow groundwater by clogging gravel and sand beds; and burial and loss of aquatic vegetation (Wood and

Armitage 1997, Yamada and Nakmura 2002, Cederholm et al. 1981, Petts 1984a, Pringle and Ramirez 1998, Brookes 1986, Nuttall 1972, Edwards 1969, Van Nieuwenhuyse and Laperriere 1986, Connolly and Pearson 2007, and Davies-Colley et al. 1992). Where these effects persist (as has been the case in areas impacted by road construction), the additive nature of individual on-site road erosion processes and erosion features, coupled with the consequent changes/impacts to off-site physical and hydrologic processes and biological resources, are referred to as "*cumulative effects*" (Ziemer and others 1991, Reid 1993).

The delivery of massive volumes of sediment to rivers has resulted in significant ecological damage. The scientific literature reports many examples of pools, gravel riffles, and other important habitats buried in fine sediment such that fish and other aquatic organisms are unable to reproduce, feed, or find cover, leading to the loss of formerly productive fisheries (e.g., Cordone and Kelley 1961, Iwamoto et al 1978). For example, Fossati et al. (2001) documented impacts of sediment releases from road construction on aquatic ecology of the Río Coroico, in the tropical humid-climate Yungas region of Bolivia, concluding that "Suspended solids … had a clear negative effect on invertebrate density (200-fold decrease in abundance) and diversity (6-fold decrease in number of taxa)".

While the literature reports these effects from all parts of the globe, including Asia, Europe, Australia, and Latin America, and in a wide range of climates from northern-latitudes to the tropics, the effects have been especially well-documented in North America, in the forests of California and the Pacific Northwest, where logging roads were once constructed using exactly the same practices that we documented on Route 1856. For example, roads built with similar problems to Route 1856 constructed to cut timber in the Quinault River basin, Washington, were identified as key sources of erosion and sediment to the river, resulting in a near-complete destruction of a sockeye salmon run that formerly numbered a million adult fish annually (Brown 1982), and which has still not recovered after over four decades in which such practices have been outlawed and numerous restoration projects attempted. Another example of road-related impacts and devastating consequences to salmon populations in Washington occurred in the Clearwater River catchment. Road-related landslides, sidecast erosion, gullies, and debris-flows delivered substantial amounts of sediment to the river (Reid et al. 1981), and resulted in severe impact to spawning salmon populations (Cederholm et al 1981). Redwood National Park in northern California, home to the tallest trees in the world, is still recovering from the effects of high sediment loads, as described in the Literature Review presented in Appendix C. Of course, every river has a different ecosystem, but these examples illustrate the principle that the contribution of large volumes of fine sediment to river systems can significantly impact riverine ecology.

3.1.5 Summary

In sum, roads disturb pre-existing natural drainage patterns, increasing storm runoff from a given rainfall, and more importantly, concentrating surface runoff such that it is capable of eroding gullies and transporting sediment and contaminants to the river system. Roads cut across steep hillslopes concentrate runoff even more by virtue of the steep slopes, and if runoff down roads and adjacent ditches is not frequently diverted and spread to infiltrate, the effect of gullying and road surface erosion is exaggerated with the steep topography. More importantly, the cut and fill required to put the road across a slope has the potential to induce landslide failure of the cut banks and failure of fill prisms. In essence, the entire volume of material moved to make the road becomes vulnerable to mass wasting and particulate erosion. As a result of these multiple effects, road-related sediment can dominate the sediment budget in many river systems (Reid and Dunne 2003). The increased sediment loads to rivers are documented to have caused the loss of aquatic vegetation, macroinvertebrates, amphibians, and valued fish species, as well as degraded water quality. These effects have been documented in multiple sites around the globe in a wide range of ecosystems.

3.2 Increased Area of Disturbance by Route 1856 over pre-existing roads

While some of Route 1856 has been constructed on pre-existing local roads, more than half of the road is completely new construction, much of it on steep terrain. Our analysis of conditions appearing under the 2012 footprint of Route 1856 on the 2009 satellite imagery indicates that 51.7 km (48%) of the Route 1856 alignment follows sections of pre-existing road, and 56.3 km (52%) is completely new construction (Table 1). Even where Route 1856 follows sections of pre-existing road, Route 1856 has a significantly larger footprint. The pre-existing road segments were mostly located across broad, flat or gentle floodplain/river terrace settings, where roads were easily put across the landscape without heavy construction equipment, and where they provided access to areas cleared for agriculture. The new road has a larger footprint, so creates significantly more impermeable surface (Figures 4, 5). Moreover, the fact that Route 1856 can support higher vehicular use levels means that it will also lead to higher future erosion rates emanating from the roadbed and traveled surface. Sections of pre-existing flat road converted to larger road by construction of Route 1856 will cause higher rates of erosion and sediment delivery to the Río San Juan, depending in large measure on how these sections of Route 1856 are surfaced and drained.

Table 1. Road status by terrain type for Juan Rafael Mora Porras Route 1856, Costa Rica

Road segment	Gentle terrain				Steep terrain				Total			
	Preexisting road		New construction		Preexisting road		New construction		Preexisting road		New construction	
	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)
Above Río San Carlos	3.1	8%	13.4	32%	2.6	6%	22.5	54%	5.7	14%	35.9	86%
Above Río Sarapiquí	24.5	59%	11.4	28%	4.1	10%	1.2	3%	28.6	69%	12.6	31%
Above Río Colorado	17.4	69%	6.9	27%	0	0%	0.9	4%	17.4	69%	7.8	31%
Total	**45**	**42%**	**31.7**	**29%**	**6.7**	**6%**	**24.6**	**23%**	**51.7**	**48%**	**56.3**	**52%**

Figure 4. Extent of ground disturbance, deforestation and site conditions as shown on 2009 photography (pre-Route 1856) and 2012 photography (after Route 1856 construction) at Isla Reloj – Palo Seco.

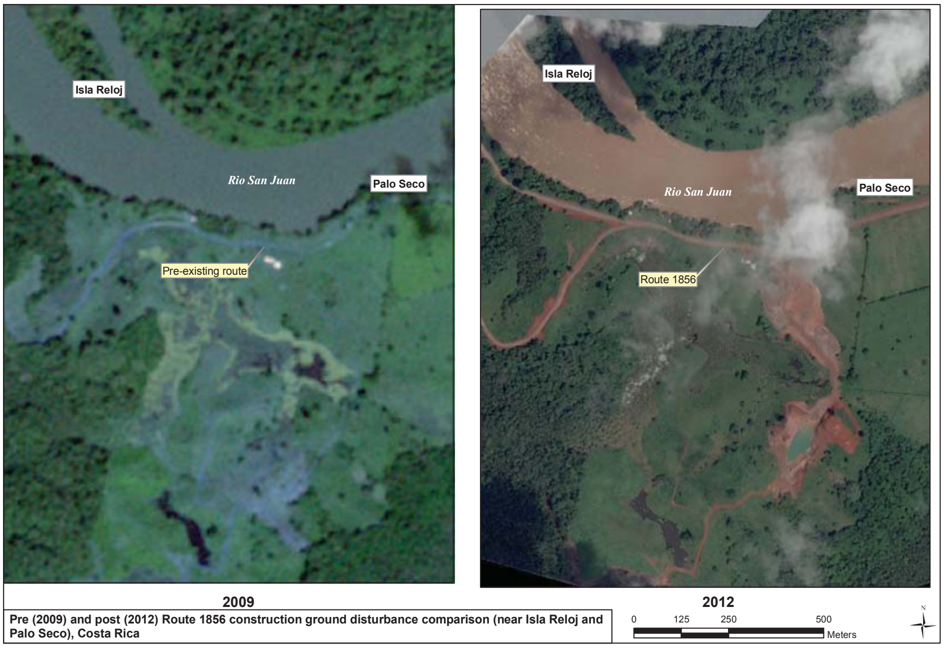
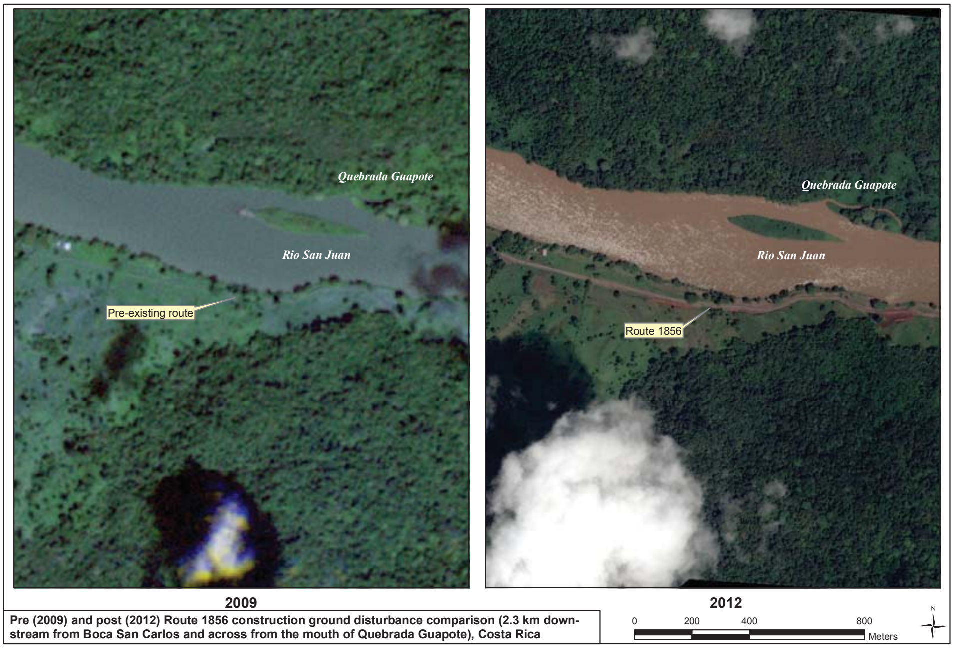


Figure 5. Extent of ground disturbance, deforestation and site conditions as shown on the 2009 photography (pre-Route 1856) and 2012 photography (after Route 1856 construction), 2.3 km downstream from Boca San Carlos and across from the mouth of Quebrada Guapote).



Perhaps more significantly, of the 56.3 km of Route 1856 that consists of entirely new construction, 24.6 km is located on steep terrain, much of it densely forested areas (Table 1, above) (Figure 6). Newly-constructed roads across steep topography are prone to erosion and landsliding by virtue of their setting. The erodibility of the steep slopes has combined with the poor construction practices employed in the construction of Route 1856 to produce multiple landslides, extensive gullying and other easily identifiable erosional features.

Figure 6. Photo #50b at km 14.3 from upstream end of Route 1856 along border. Newly constructed road crosses very steep topography resulting in a >50m wide area of bare soil prone to surface, gully and landslide erosion with a high risk for sediment delivery to the Río San Juan.

3.3 Deforestation

Where a new road is constructed through forested terrain, the pre-existing vegetation must be removed to make way for the road, its attendant quarries, and spoil areas. The resulting deforestation constitutes another impact of the road.

Deforestation results in loss of important ecological habitats, carbon sequestration, and other ecological values, especially in the humid tropics, where cutting of forest is acknowledged to be a principal contributor to greenhouse gas emissions. Tropical forests have high diversity of plant and animal species, and high levels of endemism (unique ecological features to a limited geographic area). Thus, any project affecting large areas of mostly undisturbed forest will have a high potential for environmental impact, and should be subject to careful, scientifically sound environmental impact assessment. (No such assessment was conducted for Route 1856.)

Deforestation is known to increase soil erosion by removing the protective layer of vegetation cover, decreasing the amount of rain that infiltrates into the soil and groundwater, and increasing the amount of storm runoff (which increases soil erosion), and as roots decay, leading to loss of slope strength and increased rates of shallow and deep-seated landsliding. Looking at the 41.6 km of the road upstream of the Río San Carlos confluence, which traverses the steepest topography and where 86% of Route 1856 is new construction, there was a total of 99.8 ha of disturbed land, of which 41.6 ha involved removal of previously undisturbed forest (Tables 1, 2, 3).

Table 2. Road and crossing status by terrain type for Juan Rafael Mora Porras Route 1856, Costa Rica

Road segment	Gentle terrain				Steep terrain				Total			
	Length		Stream crossings		Length		Stream crossings		Length		Stream crossings	
	(km)	(%)	(#)	(%)	(km)	(%)	(#)	(%)	(km)	(%)	(#)	(%)
Above Río San Carlos	16.5	21%	30	52%	25.1	80%	56	82%	41.6	39%	86	68%
Above Río Sarapiquí	35.9	47%	24	41%	5.3	17%	12	18%	41.2	38%	36	29%
Above Río Colorado	24.4	32%	4	7%	0.9	3%	0	0%	25.3	23%	4	3%
Total	**76.8**	**100%**	**58**	**100%**	**31.3**	**100%**	**68**	**100%**	**108**	**100%**	**126**	**100%**

Table 3. Area of disturbance and areas of forest harvesting pre- and post- Route 1856 construction by terrain type for the road upstream of the Río San Carlos, Costa Rica

Forest disturbance time period	Gentle terrain			Steep terrain			Total		
	(km)	(Ha)	(%)	(km)	(Ha)	Area (%)	(km)	(Ha)	Area (%)
2009: Pre- road construction	15.82	26.8	27%	0.64	31.4	31%	16.46	58.2	58%
2012: Post- road construction	11.91	0.7	1%	13.23	40.9	41%	25.14	41.6	42%
Total	**27.73**	**27.5**	**28%**	**13.87**	**72.3**	**72%**	**41.6**	**99.8**	**100%**

4. RESULTS: PROBLEMS DOCUMENTED WITH ROUTE 1856 CONSTRUCTION

Based on our observations from aerial and field reconnaissance, and supported by analysis of aerial imagery, we have identified the following specific deficiencies with the construction of the Route 1856.

4.1 Lack of Planning

As noted by CFIA (2012), Route 1856 has been built without plans and without benefit of an environmental impact analysis. Transportation planning, involving a team of qualified and trained specialists, was not employed. The lack of planning has resulted in siting the road across steep, unstable hillsides, as discussed below where alternative (less damaging) routes were available. There are many places along Route 1856 where it is obvious that the construction crew began to put the road along one route, only to abandon the partially completed route and build the road elsewhere (Figure 7). In such cases, the disturbance that would be expected from constructing a road is effectively doubled.

Figure 7. Photo #60b at km 15.0 from upstream end of Route 1856 along border. Example of non-right-of–way pioneered road cuts that have not be properly located, designed or decommissioned. To the right of the abandoned road, note the large stream crossing with actively eroding fillslopes and severe sedimentation in the foreground.

4.2 Encroachment of Route 1856 into 50-m setbacks

Our analysis showed that a total of 17.9 km of Route 1856 has encroached into the 50-m setback (specified by Costa Rican law) from the bank of the Río San Juan (Table 4), with the road coming within approximately 5 m of the river bank at a number of locations (Figures 8, 9). The upstream section of the road (above the Río San Carlos confluence) had the highest rate of setback violation, with 12.3 km of the road, or 30% of the stretch, located within 50 m of the river bank. It should be noted that this measurement includes only the road itself, and does not include the numerous new driveways, residential clearings and initial attempts to construct the road that were abandoned in favor of another route. Many of these clearings and disturbances were also within the setback.

Table 4. Length of road within 50-m buffer by terrain type for Juan Rafael Mora Porras Route 1856, Costa Rica

Road segment	Gentle terrain				Steep terrain				Total			
	Within 50-m buffer		Outside 50-m buffer		Within 50-m buffer		Outside 50-m buffer		Within 50-m buffer		Outside 50-m buffer	
	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)
Above Río San Carlos	9.1	22%	7.4	18%	3.2	8%	21.9	53%	12.3	30%	29.3	70%
Above Río Sarapiquí	3.7	9%	32.2	78%	1.9	5%	3.4	8%	5.6	14%	35.6	86%
Above Río Colorado	0	0%	24.4	96%	0.0	0%	0.9	4%	0	0%	25.3	100 %
Total	**12.8**	**12%**	**64.0**	**59%**	**5.1**	**5%**	**26.2**	**24%**	**17.9**	**17%**	**90.2**	**83%**

Figure 8. Photo #40 at km 8.3 from upstream end of Route 1856 along border. 17% of Route 1856 has been constructed within 50 m of the Río San Juan, and upstream of the Río San Carlos, 30% of the road is within 50 m (Table 4, above). Many of these locations, exhibit active and ongoing sediment delivery to the Río San Juan.

Figure 9. Photo #121b at km 39.0 from upstream end of Route 1856 along border. Route 1856 has been constructed well within 50 m of the Río San Juan. Note the extensive surface erosion along the road, as well as large cutbank landslides, the poorly constructed stream crossing in the middle right, and the lack of any erosion control or wet-season stabilization efforts.

While the precise pathways of sediment delivery from an eroding road to a nearby water body depend on local topography and other factors, it is an accepted principle that building close to a river or other water body increases the likelihood that sediment from the road will reach the water body. This principle is the basis for establishing setbacks to protect rivers and other waters from disturbance by roads, farming, and other activities. Based on our experience assessing impacts of roads and other land-use disturbances, we consider 100 m to be a more appropriate buffer distance, as an indication of which sections of road are likely to contribute eroded sediment directly to the river. Our analysis showed that 49.5 km of the road was within 100 m of the riverbank, 17.8 km of which was built on steep terrain (Table 5). Thus, nearly half of the road was built within 100 m of the river, greatly elevating the potential for the road to negatively impact the Río San Juan.

Table 5. Length of road within 100-m buffer by terrain type for Juan Rafael Mora Porras Route 1856, Costa Rica

Road segment	Gentle terrain				Steep terrain				Total			
	Within 100-m buffer		Outside 100-m buffer		Within 100-m buffer		Outside 100-m buffer		Within 100-m buffer		Outside 100-m buffer	
	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)
Above Río San Carlos	14.5	35%	2.0	5%	13.8	33%	11.3	27%	28.3	68%	13.3	32%
Above Río Sarapiquí	14.9	36%	21.0	51%	4.0	10%	1.3	3%	18.9	46%	22.3	54%
Above Río Colorado	2.3	9%	22.1	87%	0.0	0%	0.9	4%	2.3	9%	23.0	91%
Total	**31.7**	**29%**	**45.1**	**42%**	**17.8**	**16%**	**13.5**	**12%**	**49.5**	**46%**	**58.6**	**54%**

4.3 Poor Siting of Road

One of the principles of sound practice in road construction is selecting the best route, through the most stable terrain, and avoiding sensitive wetlands. Route 1856, however, which was not the subject of planning or impact analysis, was built across potentially unstable hillslopes in many localities. Over 30 km of Route 1856 has been built across steep hillslopes, many composed of deeply weathered, unconsolidated, or otherwise weak material, which is prone to erosion and slope failure (Tables 1 & 2, above). As noted above, nearly half of the road is located within 100 m of the river bank, greatly increasing the likelihood that sediment eroded from the road will enter the river (Table 5).

The poor siting of the road – across steep, unstable hillslopes and in close proximity to the river – was a tragic error with significant short- and long-term environmental consequences. There is no technical or environmental reason the road needed to go where it was put. In fact, the contrary would be true: better sites with more stable ground and located a greater distance from the river would have resulted in far less environmental impact, and over the long run, far less expense in attempting to maintain a poorly-sited, poorly-constructed road.

4.4 Disorganized Cuts and Fills

As obvious from our aerial and riverboat reconnaissance, from analysis of aerial imagery, and from the reports and images presented by CFIA (2012) and LANAMME (2012), the construction of Route 1856 has not been carried out in an organized or professional manner. The construction has involved excessive and disorganized earthmoving works, a function of the lack of planning. By failing to implement the measures necessary to protect the resulting cuts and fills from wind, rain, runoff, and even gravity, the disorganized construction of this road in a fragile environment created a situation in which sediment transfer to the Río San Juan and the tributaries that feed it was inevitable.

4.5 Steep Cutbanks and Unstable Fill

As a general rule, the steeper the cutbank, the more prone it is to slope failure. We observed numerous examples of steep cutbanks that have already failed, both along the road itself and in nearby rock quarries (Figure 10). As the exposed cutbanks continue to weather, and as the area is exposed to more intense rains, these vulnerable slopes will inevitably experience a high rate of slope failure and continuing erosion.

Figure 10. Photo #100b at km 24.2 from upstream end of Route 1856 along border. Unstable quarry located well within 50 m of Río San Juan displaying widespread surface erosion, as well as cutbank and hillslope instabilities resulting in direct sediment delivery to the Río San Juan.

Along most of Route 1856, fill materials were clearly sidecast downslope (i.e., simply pushed to the edge of the road and allowed to fall down the slope). Fillslopes created in this way are inherently unstable, because they exist at excessively steep slopes, and because they consist of loose fill, without the benefit of compaction. From our helicopter aerial and riverboat inspections, we observed few newly constructed fillslopes that did *not* clearly exhibit widespread settlement, slope failure, and mass movement of material following construction (Figure 11).

Figure 11. Photo #41 at km 8.2 from upstream end of Route 1856 along border. Poorly constructed, primarily sidecast, fillslopes are nearly ubiquitous where Route 1856 is located on steeper hillslopes. These failing road fills actively deliver significant quantities of sediment to the Río San Juan. We observed limited to no efforts to implement emergency erosion control efforts.

Several fillslopes appeared to have large pieces of dead wood incorporated into the fills, or living trees that were buried by sidecast fill (Figure 12). These construction methods – sidecasting, lack of compaction, and incorporation of woody debris in fill materials – are a recipe for continued slope failure and off-site sediment delivery. These poorly built cuts and fills represent “loaded guns” on the landscape that are waiting to be triggered to fail during storms and floods.

Figure 12. Photo #70c at km 18.3 from upstream end of Route 1856 along border. Lack of any plans, design or construction standards along Route 1856 has resulted in excessive sidecasting, incorporating woody debris in the fills, burying live trees. These poorly constructed road segments currently impact the Río San Juan, and will pose long term threats to water quality.

Similar construction practices were commonplace in the Pacific Northwest of North America in the 1950s and 1960s, and they created a legacy of problems that persist to this day, including fish populations that have never recovered their pre-disturbance levels, continued slope instability in many sites, excessive sediment supply persisting in many rivers such that aquatic habitats are still degraded and cannot support fish and other species as formerly. These destructive road-building practices were prohibited in California by the Forest Practice Act of 1974, in other states by comparable legislation, and are effectively banned by the federal government for all publicly owned forest lands in the United States, as discussed below in Section 4.10.

The observed construction practices of Route 1856 point to the apparent lack of geotechnical assessments as well as failure to apply standard engineering and construction practices for the location of the right-of-way, cut and fill design, appropriateness of spoil disposal locations, road surface drainage and stream crossing designs, and material compaction standards. These deficiencies are pervasive, with examples of resultant, severe fillslope, cutbank and native hillslope failures associated with various locations along Route 1856 (Figure 13). Because so much of the steeper sections of Route 1856 are within 100 m of the river bank (of the total 31.3 km that crosses steep terrain, 17.8 km is within 100 m of the bank), the risk of ongoing and future sediment delivery to watercourses and to the river is very high (Table 5).

Figure 13. Photo #77 at km 18.5 from upstream end of Route 1856 along border. Unstable cutbanks and fill prisms are common where Route 1856 has been constructed across steeper topography. Where the road is close to the Río San Juan, the risks of sediment delivery will remain high into the future, even with the implementation of very costly engineering measures. These road segments should be properly decommissioned and the road re-routed well away from the river.

At many locations, fillslopes appear to be actively adjusting and virtually "melting" downslope with little evidence of maintenance or corrective effort along the route (Figures 14, 15). As a consequence, accelerated human-caused erosion processes remain unchecked, and sediment continues to be delivered directly to the Río San Juan.

Figure 14. Photo #74 at km 17.8 from upstream end of Route 1856 along border. Examples of poorly constructed fillslopes that are unstable, and are literally “melting away” immediately following construction. These construction practices coupled with the location of the road adjacent the Río San Juan are now and will continue to impact water quality for decades.

Figure 15. Photo #42 at km 8.4 from upstream end of Route 1856 along border. Examples of poorly constructed fillslopes that are incredible unstable, and are literally “melting away” immediately following construction. These construction practices and the location of the road adjacent the Río San Juan are now and will continue to impact water quality for decades.

4.6 Deficient, Eroding Stream Crossings

From our field inspection (from aerial overflight and riverboat inspections) of approximately 60 recently constructed stream crossings, we observed that essentially all road-stream crossings exhibited some form of serious design and/or construction deficiency, such as:

1. Poorly sized culvert drainage structures, clearly insufficient to accommodate 50-year or 100-year design peak flows (the lack of plans for the road mean there is no statement available regarding design flows) (Figure 3, above);

2. Culverts too short to construct stable fillslopes (Figure 16);

3. Excessive sidecasting and poorly compacted fills on the approaches to individual road-stream crossings (Figure 17);

4. Use of logs and other non-conventional, inappropriate drainage structure materials (instead of metal culverts or bridges) that are already in the process of failing (Figure 18);

5. Use of logs for headwalls and slope retaining walls that will eventually rot and fail (Figure 19);

6. Stream crossings lacking any formal drainage structure (Figure 20);

7. Large, deep fill crossings on some stream channels with elevated drainage structures (culverts) that have dammed streams and caused the creation of ponds and small reservoirs with unknown fill and spillway stability (Figures 3, 17, 21); and

8. Misaligned culverts placed outside the natural stream channel, with poorly designed man-made ditch outlets that carry flow downslope directly to the Río San Juan (Figure 22).

At virtually all the observed stream crossings, some volume of sediment has been introduced directly into the receiving tributary stream and to the Río San Juan during construction of the crossing. More importantly, most road-stream crossings along the newly built road pose a moderate to high risk of future failure because they are significantly undersized or they were poorly constructed (Figure 23). Stream crossing failures will occur when storm flows cause culverts to plug or culvert capacity to be exceeded, and the fill is eroded or the stream is diverted onto adjacent, unprotected hillslopes leading to the Río San Juan. These diverted streams cause road and hillslope gullies that will result in additional volumes of gully erosion and sediment delivery to the receiving tributaries and to the Río San Juan.

Figure 16. Photo #93b at km 20.1 from upstream end of Route 1856 along border. Culvert has been installed with insufficient length to construct stable 2:1 fillslopes. Between the culvert outlet and the Río San Juan, an over-steepened man-made ditch conveys runoff to the river. Note the submerged delta of recently deposited sediment in the foreground.

Figure 17. Photo provided by INETER based on 1st of December, 2011 site visit. Excessive sidecasting, poor compaction and the culvert placed high in the fill are combining to cause immediate sedimentation in the Río San Juan. This style of road construction will ensure long-term impacts to the Río San Juan in the future.

Figure 18. Photo from CFIA report dated June 2012. Stream crossing built with non-conventional materials are already failing and delivering sediments to tributary streams during every rainfall and runoff event. It is also likely the drainage structure is not properly sized for 50- or 100-year discharges.

Figure 19. Photo #95e at km 21.75 from upstream end of Route 1856 along border. Use of logs as headwalls and other inappropriate crossing materials will increase the failure potential of the drainage structure and result in additional sedimentation to the Río San Juan.

Figure 20. Photo from CFIA Report dated June 2012. Several Costa Rican reports have identified many locations along Route 1856 where stream drainage structures are totally lacking, undersized, poorly installed and are actively delivering sediment to the tributary streams crossed by the road. In addition, the photo illustrates no efforts at protecting bare soil areas adjacent the stream from surface and gully erosion processes.

Figure 21. Photo #29 at km 7.1 from upstream end of Route 1856 along border. Several new reservoirs where observed where Route 1856 crossed larger watercourses with big fill crossings. Based on the methods of construction observed elsewhere along the road, it is likely the stream drainage structures are undersized and poorly installed, and likely have inadequate spillways at these new earthen dams.

Figure 22. Photo #51c at km 11.3 from upstream end of Route 1856 at border. Road and culvert (not visible) are in the distance in the sunlight. Man-made ditch has been constructed to convey runoff to the Río San Juan where the photo was taken. Note the poor design and over-steepened sideslopes to the ditch.

Figure 23. Photo of bridge being constructed across Cano Curenita about 58 km downstream from the upstream end of Route 1856 along border. Bridges are appropriate for this larger stream, however significant volumes of sediment are being delivered to the Río San Juan as a result of construction activities including extensive ground disturbance, sidecasting and perching over-steepened fill over the stream, and the lack of surface erosion control measures.

4.7 Rainfall Intensity and Erosion Potential

Erosion potential is a function of both the extent and nature of exposed earth, and the intensity of the expected rainfall. In this tropical region, rainfall intensities can be very high, especially during tropical storms and hurricanes. In general, precipitation increases toward the Caribbean: average monthly rainfall for July is 417 mm at El Castillo, but 748 mm near the coast at Barra del Colorado. The *maximum* monthly totals for July were 666 at El Castillo and 1719 mm at Barra Colorado. With more than a meter and a half of rain falling in a single month, this region can experience very intense and prolonged rains, and consequently erosion potential can be viewed as high. And these numbers do not reflect the rainfall likely during a hurricane, when rainfall intensities over just a few hours can be very high. The high erosion rates and extensive landsliding during Hurricane Mitch in 1998 (Molnia and Hallam 1999) resulted from four-day rainfall totals in Honduras of 896 mm and maximum rainfall intensities of 58 mm per hour (Hellin and Haight 1999).

However, it is important to recognize that hurricanes are natural events, the effects of which are made much worse by prior land disturbance. It is the combination of prior bad land management and the intense rainfall that occurs during hurricanes and tropical storms that leads to serious damage. The extreme destructiveness of Hurricane Mitch (with extensive landsliding and 11,000 lives lost) was due not to unusually high totals or intensity of rainfall, because rainfalls, while clearly high, were "less than values from the updated maximum potential rainfall curve." Rather, "already saturated soils and denuded hillsides, were largely responsible for the damage caused" (Hellin et al. 1999). Looking ahead to the next hurricane to hit the region, we can see that the extensive disturbance caused by the sloppy construction of Route 1856 has set the stage for significant damage.

Since construction of Route 1856 began in 2011, the region has experienced relatively modest rainfalls. Estimated monthly rainfalls for El Castillo in 2011-2012 have been less than 285 mm, except for three months: October 2011 (437 mm), May 2012 (537 mm), and July 2012 (544 mm) (Accuweather 2012). These rainfalls are certainly enough to erode soil and deliver sediment to the river, as we have documented. However, all of the rain falling in the wettest month of 2011-2012 could fall in a few days during a hurricane, resulting in vastly greater erosion, landsliding, and sediment delivery to the river.

4.8 Poor Drainage and Lack of Preparation for Wet Season

Construction of Route 1856 has left behind large areas of exposed soil, disrupted hillslope topography, steep cutbanks, and mounds of loose, unengineered (uncompacted) fill. Normally any such construction project should be protected from rain impact and landsliding by erosion control measures and slope stabilization measures. To prevent the washing away of exposed earth, it is standard procedure to cover exposed areas with a complete cover of mulch, with quick-growing vegetation (e.g., grass), or, where no vegetation exists (or it has been planted but has not yet grown in), protective geotextiles and erosion-control fabrics. Measures such as replanting with native plant species are recommended by the Costa Rican Management Plan, but we observed evidence of little successful effort in this direction. Most of the bare exposed ground surfaces of Route 1856 have not been protected by mulch, vegetative cover, or geotextile substitutes. In cases where geotextiles have been installed, they have mostly failed. In some cases, large plastic sheets have been placed over cutslopes in an evident attempt to prevent slope failure, but this approach works only to control surface erosion, not landslides, which may have deep failure planes, nor have any of the poorly implemented measures been maintained or successfully repaired.

Route 1856 has long lengths of road surfaces that drain to inboard ditches. Not only is the runoff from a given rainfall increased because the compacted road surface does not infiltrate, but the runoff is collected and concentrated such that road surface and ditch erosion is virtually guaranteed to occur, and where these concentrated flows are discharged onto adjacent fills and native slopes, severe gullying results. The lack of adequate road surface drainage structures is reflected in the consequent widespread and serious gully erosion, which efficiently delivers eroded sediment directly to the Río San Juan (Figure 24). Moreover, the disruption of surface and groundwater flow paths by the road results in unnatural concentrations of water, which can reduce slope stability and trigger landslides and debris flows.

Figure 24. Photo #33 at km 7.5 from upstream end of Route 1856 along border. On steeper terrain, massive gully and surface erosion are occurring on all road related disturbed areas. Along the road, three > 2 m wide by > 2 m deep gullies associated with concentrated road runoff are present. Likewise, the quarry area exhibits extensive actively enlarging gullies during every rainfall event. Note the youthful grasses over deltaic deposit in the foreground.

An important component of any road construction project of the scale of Route 1856 is to stabilize or "put the project to bed" before the onset of the rainy season. This involves the application of well-known storm water pollution prevention measures (best management practices or "BMPs") that are designed to control erosion and prevent the off-site transport of eroded sediment. These BMPs include water bars, berm breaks, sediment basins, mulching, erosion-control fabrics, filter fences, seeding and other temporary road surface drainage and erosion control measures. However, we observed unprotected, eroding bare soil areas to be ubiquitous throughout virtually all construction areas along the alignment. The evident lack of measures to prepare for the wet season and lack of erosion control measures along the route has resulted in persistent and serious erosion of bare soils all along the recently bulldozed alignment and at disturbed rock quarry sites. Much of this eroded sediment has been delivered to the Río San Juan.

4.9 Impacts on Tributaries and Hydrologic Connectivity to Río San Juan

We mapped 126 stream and river crossings along Route 1856 (Table 2, above). Each crossing is a potential location for delivering road-derived sediment to tributary streams and ditches, which serve as conduits to efficiently transport sediment to the Río San Juan (Figure 24, above). Rainfall erodes sediment from exposed road surfaces and its attendant cuts and fills, washing sediment into nearby water courses, thereby posing a threat to the tributary streams and the mainstem river to which they drain.

In our observations from helicopter, boat, and aerial imagery, we documented that a large proportion of the road is *hydrologically connected* to nearby streams, and through them, to the mainstem river. Hydrologic connectivity means that rain running off the road will flow directly into the channel system, instead of taking a slower path through vegetation or infiltrating through the groundwater, as was dominantly the case prior to road construction. The new road was built with inside ditches and flat or in-sloped road surfaces, thereby efficiently routing most runoff and eroded sediment directly to adjacent streams. If the approaches to a road-stream crossing are long and/or steep leading to the adjacent tributary stream crossing, road surface gullying adds to the sediment load in road surface runoff.

Hydrologic connectivity greatly accelerates man-caused sediment delivery to off-site, downstream areas and can seriously impact channel morphology and aquatic habitat a great distance from the construction site. In fact, depending on how road beds are shaped and drained (i.e., do they collect and concentrate runoff or disperse road runoff at many non-stream drainage points along the road) dictates whether the road's segments are well connected or the opposite, "shaped to be hydrologically invisible" on the landscape, which would be typical of best management practices today in North America. Highly connected roads can be significant and persistent sources of man-caused accelerated sediment delivery, and they represent active sediment sources even in light rainfall events.

Construction of Route 1856 has significantly affected all of the watercourses crossed by the road, by changing or interrupting their natural flow patterns and by causing eroded sediments and other materials to be transferred into them. Such effects have serious implications for the Río San Juan because all these tributary bodies of water discharge into the river. As the character and quality of these tributaries are altered or compromised, so are the character and quality of the Río San Juan (Figure 25).

Figure 25. Photo #58a at km 14.1 from upstream end of Route 1856 along border. Markedly elevated sediment loads from the Río Infiernito enter the Río San Juan. Extensive earth-moving has resulted in large areas of bare soil that, as a result of poor road drainage practices, is concentrating runoff along both road approaches and delivering erosional products to the rivers. This is a classic example of hydrologically connected roads, and a practice that should be avoided.

4.10 Route 1856 Practices Now Illegal in the U.S.

The regulations established under the California Forest Practice Act (Cal. Code Regs. tit. 14 §§ 923.1, 943.1, 963.1, 923.2, 943.2, 963.2) specifically prohibit many of the practices documented in the construction of Route 1856, such as constructing a road without detailed plans, building on steep slopes near streams, intentionally discharging water and sediment directly into streams, sidecasting fill near streams, creating excessively steep cutbanks, using non-standard culvert materials, installing undersized culverts, and leaving unengineered fill, including eroding unengineered earthen road-crossing fills. By way of example, California's statute requires that "[e]xcess material from road construction and reconstruction shall be deposited and stabilized in a manner or in areas where downstream beneficial uses of water will not be adversely affected," "oversize culverts, trash racks, or similar devices shall be installed in a manner that minimizes culvert blockage," and "[certain] sidecast or fill material … shall be seeded, planted, mulched, removed, or treated … to adequately reduce soil erosion." Cal. Code Regs. tit. 14 §§ 923.2, 943.2, 963.2.

Similarly, the State of Washington Forest Practice Rules (Wash. Admin. Code §§ 222-24-010 – 060) prohibit most of the practices employed in the construction of Route 1856. Generally, Washington requires road construction to employ practices proven effective at "[p]reventing mass wasting," "[l]imiting delivery of sediment and surface runoff to all typed waters," "[p]roviding for the passage of some woody debris," and "protecting stream bank stability." Wash. Admin. Code § 222-24-010. Specifically, Washington forbids the construction of "new stream-adjacent parallel roads … within natural drainage channels, channel migration zones, sensitive sites, equipment limitation zones, and riparian management zones when there would be substantial loss or damage to fish or wildlife habitat." Wash. Admin. Code § 222-24-020. Moreover, where stream crossings are necessary, Washington requires engineers to "(a) [d]esign stream crossings to minimize alterations to natural features; (b) [l]ocate and design culverts to minimize sediment delivery; and (c) [whenever] practical, cross streams at right angles to the main channel." Wash. Admin. Code § 222-24-020. Among many other requirements, Washington also requires that "[e]rodible soil disturbed during road construction and located where it could reasonably be expected to enter the stream network must be seeded with noninvasive plant species," "[a]ll permanent culverts must be designed to pass the 100-year flood event with consideration for the passage of debris likely to be encountered," and "fills or embankments shall be built up by layering." Wash. Admin. Code §§ 222-24-020 – 040.

Likewise, the Oregon Forest Practices Rules (Ore. Admin. Rules §§ 629-625-0000 – 0650) specifically ban the types of haphazard construction methods used to build Route 1856. The Rules state:

> "A properly located, designed, and constructed road greatly reduces potential impacts to water quality, forest productivity, fish, and wildlife habitat. To prevent improperly located, designed, or constructed roads, a written plan is required in the sections listed below.
>
> "Operators must describe the specific practices, as directed by a geotechnical specialist, they will use to reduce landslide risk in a written plan. This written plan should describe specific actions taken to comply with the following rules. Avoid locating roads on high landslide hazard location…Design road no wider than necessary. Design cut and fill slopes to minimize the risk of landslides. Avoid road drainage discharge into high landslide locations…Do not place debris, sidecast, or other waste materials on high landslide hazard locations.
>
> "Maps must show the exact road location and all potentially affected high landslide locations. Cross drainage structures, cuts, and fills should also be shown. As a minimum, proposed road grades must be shown on the plan. … Use of fill on steep landslide hazard locations (60 percent) is unacceptable unless a slope stability analysis indicates such a fill will remain stable. Roads across steep landslide hazard locations should have no more than one foot of sidecast. Width should be the minimum that can be safely constructed with an excavator, typically [5 m], including the ditch."

Moreover, while road construction in the United States is mostly regulated by states under restrictions like those cited above, both the U.S. Environmental Protection Agency (EPA) and the U.S. Forest Service, have published guidance for proper road construction methods where part of federal forestry and other projects. 36 Code Fed. Regs. § 212; U.S. Forest Service, *Forest Road Construction and Maintenance*; EPA Technical Bulletin No. 0672, *Forests as Nonpoint Sources of Pollution and Effectiveness of Best Management Practices*; EPA, *Environmentally Sensitive Maintenance for Dirt and Gravel Roads.* Like the state regulations discussed above, these guidance policies prohibit road construction without preconstruction engineering planning to mitigate erosion and sediment delivery and also prohibit building on steep slopes, intentionally discharging of water and sediment directly to streams, sidecasting fill, creating steep cutbanks, and using non-standard culvert materials. 36 Code Fed. Regs. § 212; U.S. Forest Service, *Forest Road Construction and Maintenance*; EPA Technical Bulletin No. 0672, *Forests as Nonpoint Sources of Pollution and Effectiveness of Best Management Practices*; EPA, *Environmentally Sensitive Maintenance for Dirt and Gravel Roads.*

In addition, in enforcing the Clean Water Act, road-related erosion is addressed by the EPA or state agencies to whom enforcement is delegated in various contexts, including the setting of Total Maximum Daily Load standards for individual waterbodies. 33 U.S.C. § 1313(d). For rivers listed as “impaired” by sediment, road-related erosion is commonly cited as a significant sediment source and Best Management Practices for road construction are required. For existing roads, BMPs typically include improved road surface drainage and installing new drainage structures, disconnecting road drainage so it no longer flows into streams, paving the road, upgrading culvert sizes for the 100-year flood event, and stabilizing or removing unstable road fills. For new roads, construction of hydrologically connected road approaches to stream crossings is normally prohibited to reduce/minimize man-caused fine sediment inputs to streams, reduce cumulative watershed effects and protect water quality for beneficial uses.

4.11 Observed Sediment Delivery from Route 1856 to the Río San Juan

As discussed above, Route 1856 has already increased sediment delivery to the Río San Juan, and more significantly, increased vulnerability to massive influxes of sediment in future years. Sediment eroded from Route 1856 has reached the Río San Juan through a number of pathways already. These include shallow failures of sidecast fill material on sections of road located on hillslopes directly adjacent to the river channel (Figure 26A). Our field reconnaissance in these settings identified only shallow fill failures as directly connected to the river channel now, but this is the result of only modest rainfalls that have occurred over the two years since road construction began. During future hurricanes and other large storms, deep-seated landslides are likely to occur in such settings, and these events will deliver significantly larger quantities of sediment to the river.

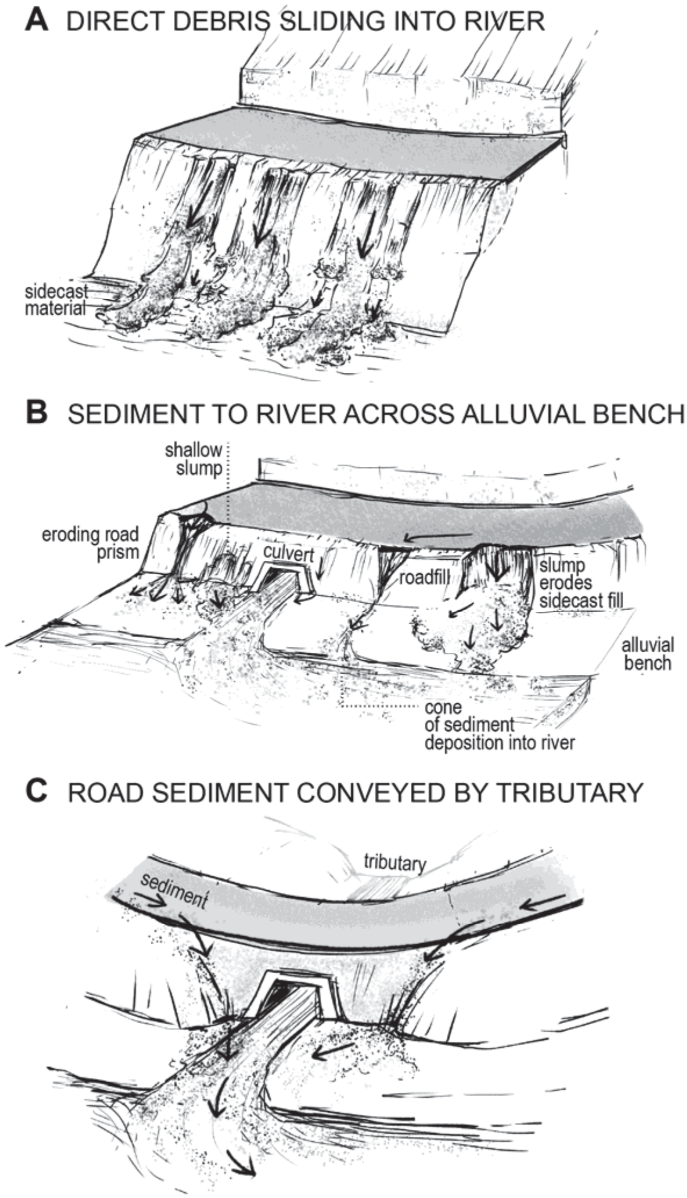
The most impressive and visible erosion and sediment delivery pathways are associated with the massive, un-engineered road-fill prisms. Concentrated road runoff has carved substantial gullies through these earthen fills, and shallow slumps are also commonly observed (Figure 26B); many of these features are directly connected to the Río San Juan. This direct sediment delivery has impacts on the Río San Juan.

<u>Figure 26.</u> Sediment eroded from Route 1856 has reached the Río San Juan through a number of pathways already (drawing prepared by Jennifer Natali from draft by Matt Kondolf).

A. On sections of road located on hillslopes directly adjacent to the river, shallow failures of sidecast fill material have entered the river. We observed only shallow fill failures directly connected to the river channel at present, but during future storms, deep-seated landslides are likely to deliver significantly larger quantities of sediment to the river by this mechanism.

B. The most impressive and visible erosion and sediment delivery pathways are associated with the massive, un-engineered road-fill prisms. Concentrated road runoff has carved substantial gullies through these earthen fills, and shallow slumps are also commonly observed, many directly connected to the Río San Juan. The earthen fills are extensively rilled and gullied, and numerous slumps have developed on them. Some of this eroded sediment has been transported across an alluvial flat (leaving a trail of angular sand and gravel) to finally discharge into the river, leaving a deposited cone of similar-sized (and finer) sediment underwater, projecting from the bankline. Some of the material eroded from these fills enters the river system at stream crossings located along the road, and some has not reached the river, but has settled on an alluvial flat of typically 10-30 m wide (where present).

C. Sediment eroded from the road surface enters the stream system at road crossings; these are the lowest points in the road system, so roads drain towards them, carrying eroded sediment. Once in the tributary, the sediments are delivered to the Río San Juan.



We also observed direct evidence that sediment from gullies in earthen road fill has been delivered to the Río San Juan. In just the 35.75 km reach between El Jardin (about 5 km upstream from the Río San Carlos confluence) and the upstream river border, we documented sediments at 43 stream/gully input points as fans, mud, etc., and documented another 11 between the Río San Carlos and the Río Colorado. In some locations, we documented a trail of angular sand and gravel across an alluvial flat to finally discharge into the river, where we could find its deposited cone of similar-sized (and finer) sediment underwater, projecting from the bankline (Figures 27, 28). Numerous slumps have developed on these road fills (Figure 29), but the failed material had not always yet reached the river. The earthen fills are extensively rilled and gullied, and much of the material eroded from these fills enters the river system at stream crossings located along the road (Figure 30). Similarly, sediment eroded from the road surface enters the stream system at road crossings; these are the lowest points in the road system, so roads drain towards them, carrying eroded sediment (Figure 26C, above). All of this sediment is then carried directly to, and discharged into, the Río San Juan via these tributary streams.

Figure 27. Photo #27a at km 6.4 from upstream end of Route 1856 along border. Insloped and bermed roads collect and concentrate runoff along long lengths of road, producing large gullies where the runoff exits the road. We estimated over 90% of the sediment derived from road erosion and the newly formed gully has been delivered to the Río San Juan, as manifest in the actively building fan/delta at the outlet of this transport pathway.

Figure 28. Photo #27c at km 6.4 from the upstream end of Route 1856 along border. Close up of the cone of sediment displaying the range of grain sizes being delivered to the Río San Juan. This is one of several dozen locations where such depositional features could be clearly seen, as depicted in Figure 26B, above.

Figure 29. Photo #75 at km 17.8 from the upstream end of Route 1856 along border. Where Route 1856 is constructed across steep topography, tall road cuts have been created, generating large volumes of fill, most of which appears to have been sidecast creating steep and long, un-compacted fillslopes. 100% of the fillslopes in the photo are exhibiting progressive failures and slumping.

Figure 30. Photo #71 at km 17.6 from upstream end of Route 1856 along border. Construction along this section of road is incomplete, yet the inappropriate road design, construction, erosion control and maintenance practices used are resulting in ubiquitous fillslope gully and landslide erosion. Poor road drainage practices are likely responsible for most of the gullies.

The fresh deposits of sediment in the Río San Juan that had clearly been transported directly from Route 1856 were of a range in grain sizes, from gravels over 90 mm down to clay. Where we could identify fresh deposits of sediment carried from the road into the river, such as in the form of cones of sediment, we documented with notes and photographs, and collected samples from a subset of the observed deposits that were directly accessible from the river, mostly cones of sediment deposited below the outflow points of transport paths from the eroding road (Figure 31). See Appendix D for photographs of the samples, along with locations and data such as percent sand, silt, and clay. We collected samples representing the range of sediment sizes observed, coarse gravels (e.g., Samples 2-1, 2-10, 2-12), well-sorted sands (Sample 2-27), and fine silt-clay (Sample 2-18, which we collected from the river margin within emergent aquatic vegetation, which had trapped silt and clay being transported from the eroding road). It is important to note that the sediment we could sample was only the “lag deposit” from a much larger sediment load that was carried into the river. 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. Most of the finer sediment has been flushed deeper into the river and carried downstream. Thus, even under the conditions of modest rainfall over the past two years, our field work demonstrated that sediment eroded from the road has reached the river in substantial amounts. 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.

Figure 31. Photo #4d at km 0.8 from upstream end of Route 1856 along border. Sediment samples were collected at several of the observed outwash deltas along the margins of the Río San Juan associated with eroding sections of Route 1856.

4.12 Estimated Ongoing and Projected Sediment Sources from Route 1856

There are two main ways that Route 1856 produces sediment, which gets to the river: 1) from chronic erosion of soil particles transported by water; and 2) from mass wasting, whose products can be transported to the river directly by mass soil movement or by flowing water. Geomorphologists have long distinguished between upland erosion rates and rates at which sediment is actually delivered to the river channel. Measured erosion rates commonly exceed rates of sediment delivery to rivers, because some sediment is stored (at least temporarily) in sites between the point of erosion and the river. Thus, in addition to estimating the volume of sediment eroded at the road itself, it is important to identify potential routes by which sediment can be transported to the river. In our field work, we documented direct delivery of sediment from road erosion to the river at 54 sites along the road.

Our estimates of surface erosion rates for the upstream 41 km of Route 1856, upstream of Río San Carlos, indicate that surface erosion is producing 17,800 to 21,300 m^3y^{-1}. Assuming that 40% of this sediment reaches the river in a given year, this amounts to 7,120 to 8,520 m^3y^{-1}. The estimated 40% sediment delivery ratio is based on:

1. Our field observations and professional experience;

2. The observations, comments and photos included in reports by Costa Rican professionals who reviewed conditions along Route 1856 (CFIA 2012, LANAMME 2012);

3. The high stream density (86 stream crossings in this section of road);

4. The high percentage of Route 1856 in this section constructed across steeper hillslopes (60%); and

5. The high percentage of the road that has been constructed within 50 m (30%) and within 100 m (68%) of the Río San Juan.

Consistent with published studies of sediment budgets in the Pacific Northwest of North America (e.g., Reid et al. 1981) and our observations of road-related erosional impacts elsewhere, we anticipate that the volumes of sediment produced by surface erosion will be considerably less that those produced by mass wasting processes. To gain a sense of the potential scale of mass-wasting and gully erosion, we measured the area of steep road cuts and fill for the 41-km section of road upstream of the Río San Carlos confluence. From this, we subtracted (in GIS) the 7-m wide roadbed itself as less likely to fail, and then conservatively estimated 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). This calculation yields a total of 218,400 to 273,000 m^3y^{-1} of sediment eroded by mass wasting and gullying. If (as above) we assume that 40% of this is reaching the Río San Juan, that implies a sediment input of 87,000-109,000 m^3y^{-1}, roughly ten times the amount estimated for surface road erosion (Tables 6 & 7).

Table 6. Road surfacing by terrain type for Juan Rafael Mora Porras Route 1856, Costa Rica

Road segment	Gentle terrain				Steep terrain				Total			
	Rocked surface road		Native surface road		Rocked surface road		Native surface road		Rocked surface road		Native surface road	
	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)	(km)	(%)
Above Río San Carlos	1.9	5%	14.6	35%	12.0	29%	13.1	31%	13.9	33%	27.7	67%
Above Río Sarapiquí	13.8	33%	22.2	54%	4.4	11%	0.8	2%	18.2	44%	23.0	56%
Above Río Colorado	22.6	89%	1.8	7%	0.9	4%	0	0%	23.5	93%	1.8	7%
Total	**38.3**	**35%**	**38.6**	**36%**	**17.3**	**16%**	**13.9**	**13%**	**55.6**	**51%**	**52.5**	**49%**

Table 7. Areas used to calculate surface, fluvial, and mass wasting erosion estimates for Route 1856 above the Río San Carlos, Costa Rica.

Terrain type	Deforestation time period	Road length (km)	Area of road bench[1] (Ha)	% Area of road bench	Disturbed area outside of road bench (Ha)	% Disturbed area outside of road bench	Total disturbed area (Ha)	% Total disturbed area
Gentle	Pre road construction	15.82	11.1	38%	15.8	22%	26.9	27%
	Post road construction	11.91	8.3	29%	23.0	33%	31.3	31%
Steep	Pre road construction	0.64	0.4	1%	0.3	<1%	0.7	1%
	Post road construction	13.23	9.3	32%	31.6	45%	40.9	41%
Total		**41.6**	**29.1**	**100%**	**70.7**	**100%**	**99.8**	**100%**

[1]Road bench area assumes 7m road width

5. RECOMMENDED EMERGENCY STABILIZATION AND EROSION CONTROL MEASURES TO PREVENT CONTINUING AND FUTURE IMPACTS TO THE RÍO SAN JUAN

5.1 Extent of Impacts

Most all of the road reaches and stream crossings we observed are exhibiting varying degrees of active, ongoing erosion as a result of inadequate planning (location), design, construction and maintenance practices. The extent of observed erosional impacts is extraordinary in scale, especially considering that the region has experienced only mild rainfall patterns over the last two years since construction began. In a hurricane or other major storm, the rate of hillslope failure and surface erosion will inevitably increase dramatically. Immediate emergency actions are needed to curtail ongoing and future erosion and sediment delivery to the Río San Juan, and these emergency actions should be of the highest priority to all parties involved.

Based on our extensive experience in controlling and normalizing wildland road erosion processes to protect water quality on both public and private road systems, we recommend the following mitigation and emergency erosion/sediment control measures be undertaken immediately. The measures include those designed to mitigate and prevent damage from 1) fillslope instability and mass wasting, 2) stream crossing erosion and failure, and 3) surface erosion from road surfaces, and 4) erosion and gullying from road surfaces, cutbanks, fillslopes and other bare soil areas. These measures are those that are required, at a minimum, to control ongoing impacts and reduce the risk of future sediment delivery to the Río San Juan from the existing road work. Their implementation should be overseen by qualified engineers and geologists specifically trained and experienced in road restoration and erosion control.

5.2 Task 1: Reduce the rate and frequency of road fill failure slumps and landslides where the road crosses the steeper hillslopes, especially in locations where failed or eroded soil materials have been or could potentially be delivered to the Río San Juan.

A. As soon as weather and soil conditions permit, mobilize heavy earthmoving equipment to excavate all unstable and potentially unstable sidecast fills and fill materials. Hydraulic excavators will be required, and in many locations temporary benches and access spur roads will be required to reach all the unstable and failing fill materials. Long boom excavators may be useful for reaching and removing unstable spoil materials where a temporary access road cannot be safely built.

B. Dump trucks will be required for endhauling the excavated spoil materials for disposal at stable, low gradient locations where the materials will have no potential for re-mobilization and delivery to streams or wetlands.

C. It should be noted that seeding, mulching or planting unstable and failing fills, or employing various fabrics designed for surface erosion control, are **not** acceptable methods for controlling mass wasting processes.

D. Once the unstable fills have been excavated and removed, the road will largely consist of a full bench road bed with little or no part of the remaining road constructed on potentially unstable fill material. If road widths are insufficient to accommodate the expected traffic in these treated reaches, either the cut portion of the road can be moved farther into the hillslope (provided the earth materials are stable) or a well designed and constructed engineered fill can be built along the outside of the road. The structural fill should be designed by a qualified engineer who should also be present during construction.

5.3 Task 2: Eliminate or significantly reduce the risk of future erosion and sediment delivery at all stream crossings along Route 1856.

A. As soon as weather and soil conditions permit, mobilize heavy earthmoving equipment to stabilize failing stream crossings by excavating all unstable or potentially unstable, poorly compacted and over-steepened fills at all road-stream crossings.

B. As soon as weather and soil conditions permit, mobilize heavy earthmoving equipment to stabilize failing or potentially unstable road fills on the immediate road approaches to stream crossings by excavating all unstable or potentially unstable, poorly compacted and over-steepened fills.

C. Endhaul the excavated spoil materials to stable spoil disposal locations where the soils will not be eroded and delivered to the Río San Juan or its tributaries.

D. Poorly designed road-stream crossings should be immediately removed until they can be properly designed and reconstructed.

   These sites include those crossings where:
   i. road-stream crossing culverts and bridges have been constructed with unsuitable materials (e.g., logs, metal shipping containers, etc.), or
   ii. stream crossing structures have not been designed (engineered) to accommodate the 100-year return interval runoff event, or
   iii. road-stream crossing bridges or culverts are misaligned with the natural channels.

   Removal of these poorly designed and/or constructed road-stream crossings should consist of:
   i. excavating and removing the drainage structure,
   ii. excavating the fill materials out of the stream crossing so as to "exhume" the original channel bed, re-establish the natural thalweg channel gradient and flood flow width, and provide stable sideslopes with maximum 2:1 sideslope, and
   iii. seed and mulch bare exposed soils for temporary erosion control.

E. The stream crossings can be properly reconstructed in the future once they have been properly designed using a) the proper materials, locations, orientations, and sized drainage structures to accommodate the 100-year flow along with woody debris that will be in transport, and b) sufficient drainage structure length to construct stable, compacted fillslopes, and transport stream flow beyond the construction site right-of-way.

5.4 Task 3: Immediately reduce road surface erosion and sediment delivery by improving dispersion of concentrated road runoff and increasing the number and frequency of road drainage structures. This measure will address gully erosion and hydrologically connected road segments that are currently delivering sediment to the Río San Juan and its tributaries.

A. As weather and soil conditions permit, and after excavating all the fillslopes exhibiting instabilities referenced in Recommendation #1 (above) along Route 1856, immediately construct temporary rolling dips, cross road drains and/or waterbars at average 15-m intervals (or more frequently) to drain road surface runoff to the outside edge of the road.

B. Construct surface drainage structures at close enough intervals so they will not result in new gully formation capable of transporting eroded sediment to the Río San Juan or its tributaries. Some erosion of the road fillslopes can be expected, but sediment should be deposited on the native hillslope beyond the base of the fill and not transported to the river or a stream. Culvert down drains can be constructed to carry road surface runoff down the fillslope wherever the road is too close to the river to prevent sediment delivery.

C. Ensure that every drain or waterbar is constructed at a slightly steeper slope angle/gradient than the existing road gradient where the drain is constructed, so that they will be self-flushing and self-maintaining.

D. Ditches should be drained under the road using ditch relief culverts installed at sufficient intervals to prevent gullying of the fillslope or the natural hillside where they discharge.

E. Ditch drains and road surface drains should be placed close to each road approach to tributary stream crossings so as to divert surface runoff onto adjacent, undisturbed (vegetated) hillslopes, and thereby prevent or minimize road surface runoff delivery to streams that flow into the Río San Juan.

F. Maintain all surface drainage structures and ditch drains so they continue to function as intended and so eroded sediment is not discharged to the Río San Juan or its tributaries. If drainage structures are damaged by traffic or equipment, they should be rebuilt immediately, and before the next rainfall and runoff event.

5.5 Task 4: Control surface erosion and resultant sediment delivery from bare soil areas that were exposed during clearing, grubbing and construction activities in the last several years.

A. Concurrent with the completion of the excavation and road drainage improvements in recommendations outlined in #1, #2 and #3 above, seed and mulch all bare soil areas with any potential for sediment delivery to nearby streams/wetlands with straw mulch at a rate of 4,485 kg/ha and native seed at a rate of 56 kg/ha. If mulches other than wheat or rice straw are employed, ground coverage should be at least 95%.

B. Cutbanks with slopes steeper than 50% will likely require the combined use of seeding, mulching and installation of rolled erosion control fabrics, stapled to the slope, to control surface erosion.

C. Inspect, re-treat and maintain all erosion control measures so they continue to function as intended and they prevent sediment delivery to the Río San Juan and its tributaries.

5.6 Engineering and Geological Evaluation

Once these temporary emergency measures have been implemented to control erosion, mass wasting, and sediment delivery to the Río San Juan and its tributaries, we strongly recommend that qualified engineers and geologists evaluate the location, design, and construction measures that were employed in the last several years, as well as those that are planned for any future earthmoving activities. Protective road design and construction standards, and Best Management Practices (BMPs) for new and reconstructed roads, should have been employed in the construction work that has occurred to date. It is clear that most of these measures were not followed, and the resulting high rates of mass wasting and gully erosion on steeper areas reflect this shortcoming. In addition to the emergency erosion and sediment control measures detailed above, it is imperative that any new or continued construction work on the Route 1856 needs to follow more formal, protective planning, design and construction BMPs if they are to avoid additional damage to the Río San Juan.

Portions of Route 1856 that have already undergone some measure of construction, and are currently exhibiting severe erosion rates or slope instabilities, will need to be completely reconstructed or realigned to more favorable locations. Ideally, any road in this general vicinity should be aligned farther inland, so as to take advantage of favorable terrain while not threatening the river or delivering eroded sediment that could impair downstream river morphology or ecology.

Sections of the current road alignment that have been pioneered or constructed close to the river, where sediment delivery is highly likely or has already occurred, should be evaluated for relocation and realignment. All future road construction should be completed only after sound professional engineering and geologic design has been completed, and only under the field supervision of engineers and geologist trained in road location, design and construction, as well as effective road-related erosion and sediment control measures.

The scientific and engineering literature is clear about the environmental and economic benefits that accompany thoughtful and sound transportation planning, road design and on-the-ground construction practices. Employing Best Management Practices for road construction and road management in the forest environment will help minimize the potential environmental impacts of the construction project, it will also minimize future maintenance requirements and storm-related impacts during seasonally wet weather and when large floods occur. Poor practices, as were employed in many locations along Route 1856 not only result in high cost, high maintenance roads that perform poorly during bad weather, they also result in unnecessarily high costs when portions of the road fail and become impassable, and when such sections need to be rerouted and the old alignment requires expensive road restoration and decommissioning measures to be permanently closed.

6. CONCLUSION

Route 1856 along the Río San Juan was badly sited and has been poorly constructed, using many of the same practices that caused extensive damage in North America in the 1950s and 1960s, and which are now explicitly prohibited. Building the road on steeply-sloping land, close to the river, has unfortunately guaranteed that serious erosion problems would result. Many of these erosion problems are clearly visible from aerial reconnaissance and from the river, and sediment transported from the eroding road can be seen and sampled in the river. 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. To a large extent, this poorly-sited, poorly-constructed road (and its extensive deforestation, slope destabilization, and extensive bare, exposed ground) has simply "set the table" for massive erosion and road failures that will occur in a major storm. The situation is exacerbated by the nearly complete lack of competent erosion control measures, leaving many parts of the road highly vulnerable to continued or increased erosion and landsliding during intense rains. The proximity of the road to the Río San Juan means that the sediment produced will be efficiently transported to the river, where it will continue to impact river ecology.

The road works suffer from a significant lack of physical and environmental planning and protection, and failed to follow international and Costa Rican river, stream and wetland setback and protection standards. Because the road was not planned and no environmental impact analysis was conducted in advance to inform the project construction, the road was sited on steeply-sloping lands too close to the river. Massive earthmoving in inappropriate locations demonstrates a lack of recognition and avoidance of potentially unstable hillslope locations. This has resulted in numerous, active fillslope and hillslope failures, ranging in size from shallow sidecast failures to large deep-seated landslides, with consequent downstream sediment delivery into the Río San Juan.

The lack of road surface drainage design, lack of road maintenance, and lack of erosion control and other environmental protections that are standard practice has resulted in numerous gullies of varying dimensions on the inadequately compacted fillslopes along the route. The constructed ditches and eroded gullies are both sources of sediment (as they rapidly erode) and act as channels that efficiently convey eroded sediment to the Río San Juan. As gullies continue to enlarge with subsequent rainfall and runoff, they can generate increasing quantities of sediment production, and further exacerbate fillslope landslides and instability.

Route 1856 crosses at least 126 streams along its 108-km length, of which 68 crossings occur in steeply-sloping terrain. Most of these road-stream crossings appear to have been deficiently constructed, based on our aerial and riverine reconnaissance, and the on-the-ground observations of CFIA (2012) and LANAMME (2012). Many are too small for the likely flows, fill material was simply dumped and not engineered for stability, and/or they have culverts constructed of unacceptable materials that are unlikely to bear the weight of truck traffic and are unlikely to survive flooding and erosion, including flimsy thin metal and wood that will rot, probably within a decade. These deficient stream crossing structures are a serious concern. The inadequately sized drainage structures and use of inappropriate construction materials at poorly constructed stream crossings have ensured that future stream crossing failures will further degrade downstream channels and the Río San Juan.

Moreover, construction of Route 1856 has involved the intentional re-routing and diversion of natural stream channels, which has focused concentrated flow to areas where erosion is accelerated and sediment delivery to the Río San Juan is virtually assured. The observed poor road drainage designs have hydrologically connected Route 1856 to the numerous stream channels it crosses, posing a significant long-term, persistent threat of cumulative, road-related and man-caused fine sediment impacts to the Río San Juan. The construction practices and inadequate design of the road and its stream crossings has effectively guaranteed that road surface erosion and fine sediments are delivered directly to tributary streams and thence to the Río San Juan.

In virtually all disturbed land area, mass wasting, gully erosion and surface erosion processes are widespread and common with few obvious efforts having been employed to control the ongoing erosion and sediment transport processes. Our review of numerous ground photos taken by Costa Rican entities, together with our own reconnaissance in October 2012, have revealed a near complete lack of secondary, post-construction erosion control measures at the many areas of exposed, bare soil created by the road-related construction and quarrying. This serious omission has resulted in significant and continuing accelerated erosion and sediment delivery to local streams and the Río San Juan. Instead of erosion control measures, it appears that little maintenance or corrective work has occurred for some time, and that the contractors rapidly demobilized their equipment and crews and left the site with little effort to stabilize the work sites or install erosion and sediment control measures prior to the beginning of the rainy season. The lack of prudent on-the-ground corrective actions continue to impact downslope and downstream water quality and resources of the Río San Juan.

The rapid, unplanned, poorly designed and poorly constructed road has clearly resulted in both on-site and off-site environmental impacts as a direct result of accelerated erosion and landsliding along the road alignment. Work on the project did not follow generally accepted or scientifically developed engineering standards and Best Management Practices related to protecting water quality and natural resources. Consequently, past and continuing erosion is widespread and unchecked, with no obvious efforts being put forth to address the observed serious problems where the road alignment crosses steeper terrain. For the 41 km of Route 1856 upstream of Río San Carlos only, we estimate that surface road erosion is approximately 18,000-21,000 m^3y^{-1}, and mass wasting of 220,000-270,000 m^3y^{-1}. If approximately 40% of these eroded volumes reach the river, this implies a sediment input into the river of approximately 100,000 m^3y^{-1}. When it happens, future erosion and sediment delivery during a tropical storm or hurricane will likely be greater than the current sediment transfer by a factor of at least 10.

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APPENDICES

A. Index Map of Location

B. Photo Atlas of Route 1856 Upstream of Río San Carlos

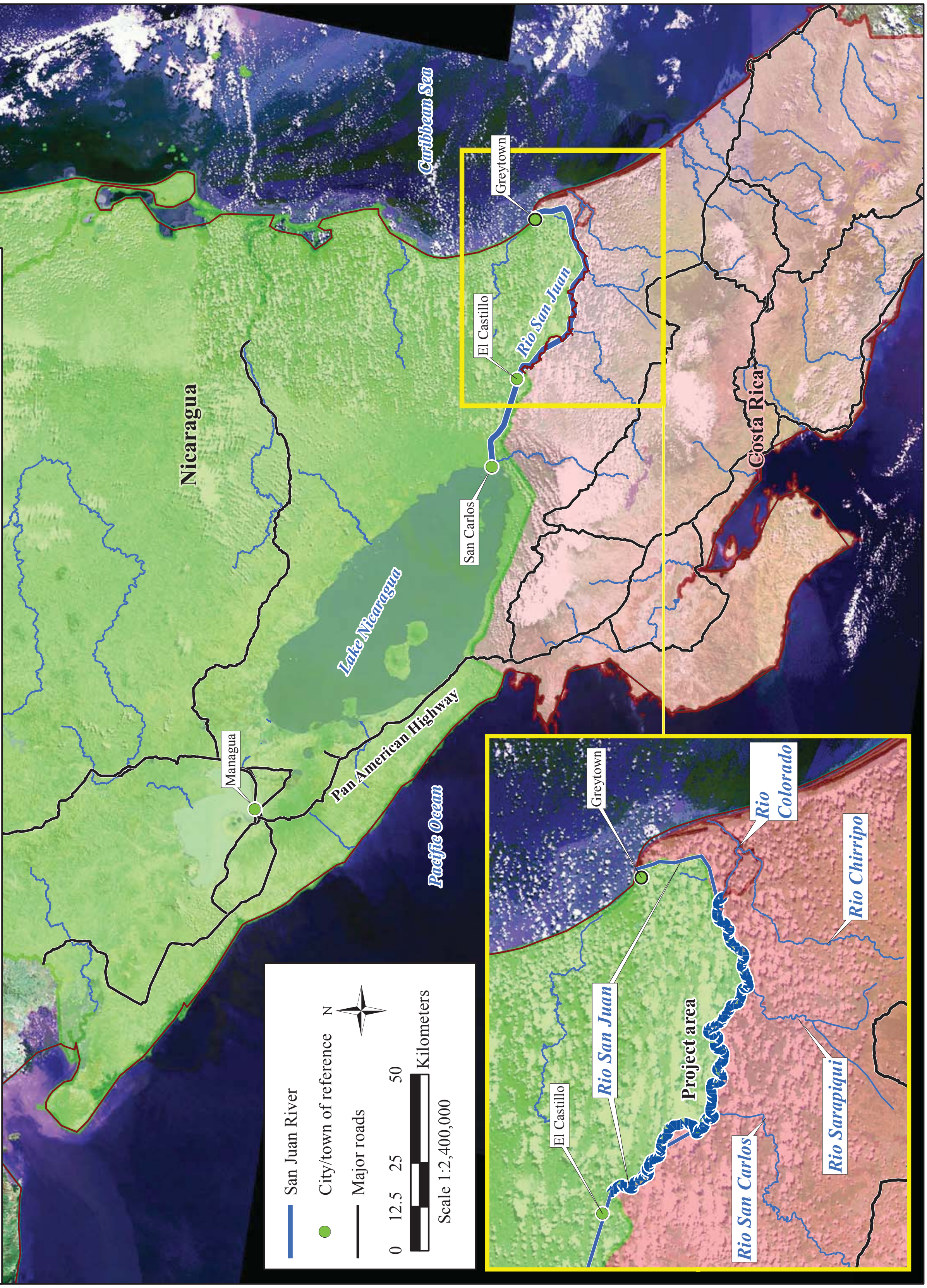
C. Detailed Literature Review

D. Grain Size of Sediment Samples

E. Large-Format Maps of Route 1856 and Río San Juan Upstream of Río San Carlos

F. Author CVs

APPENDIX A: Index Map of Location



Appendix A. Location of Costa Rica Route 1856 - Juan Rafael Mora Porroas Road adjacent Rio San Juan de Nicaragua.

APPENDIX B: Photo Atlas of Route 1856 Upstream of Río San Carlos

APPENDIX B

Aerial and river-based ground photographs depicting ongoing and potential risks of erosion and sediment delivery, caused by the 41.6 kilometers of Costa Rican Route 1856, to the Rio San Juan de Nicaragua (RSJ) above the mouth of Rio San Carlos.

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, as well as national and international physical and biological resources. The deficiencies are related to the design, location, construction, winterization erosion control and subsequent maintenance along Route 1856.

The photographs illustrate issues related to:

1. **Cutbank and hillslope instabilities,**
2. **Stream crossings and man-made ditches,**
3. **Accelerated fluvial erosion processes (gullies),**
4. **Lack of compaction and fill failures,**
5. **Sedimentation photo suites,**
6. **Concentrated road runoff issues,**
7. **Road design/location to close to Rio San Juan, and**
8. **Pioneered roads (non Route 1856) and other access roads to new developments.**

NOTE*: The photograph and their unique numbers generally proceed in a downstream direction through the RSJ starting at the upstream location where the border leaves the RSJ banks. The individual photo locations are keyed to and shown on the series of full-sized (36" x 42") sheets depicting current conditions along the RSJ above the mouth of the Rio San Carlos as observed and located on the September 2012 high resolution satellite photographs (Appendix E).*

1. Cutbank and hillslope instabilities: Road construction across moderate to steep hillslopes along many segments of Route 1856 in the upper RSJ has initiated/accelerated mass wasting processes along native hillslopes and cutbanks. The following photos are examples of just a few of the observed incipient to active instabilities that are present along the road. These features have developed and are evolving rapidly during the short time period since road construction activities began and as a result of generally average rainfall events. Given the poor road location and design standards in such close proximity to the Rio San Juan, we expect significantly elevated hillslope mass wasting processes to occur during future large magnitude storm events.


12


15


21


30


35


47


67c


77


95b


97a


100b


100c

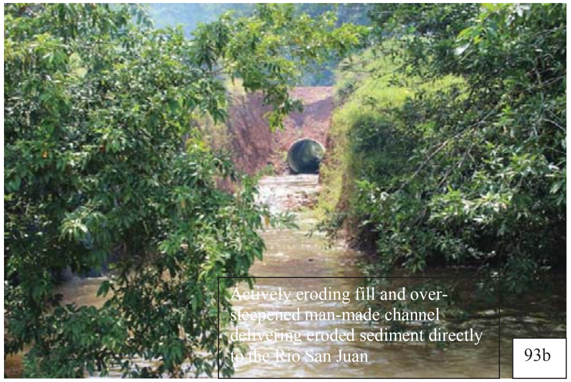

121a


34a

2. Stream crossings and man-made ditches: We have estimate there are approximately 86 streams/man-made channels with varying sized drainage areas crossed by Route 1856 in the upper RSJ above the mouth of the Rio San Carlos. Of the stream crossing we observed during the reconnaissance investigations, virtually all exhibited multiple deficiencies in design standards, construction methods and lack of any apparent maintenance activities. The following photos display the range of problems including: inadequate construction materials, lack of adequate drainage structures, poorly placed drainage structures, misaligned culverts draining to man-made newly constructed ditches, poorly compacted fillslopes and over-steepened fillslopes that are actively failing. Various degrees of active erosion and sediment delivery were occurring at the observed stream crossings .


91a

91b



93b


95e

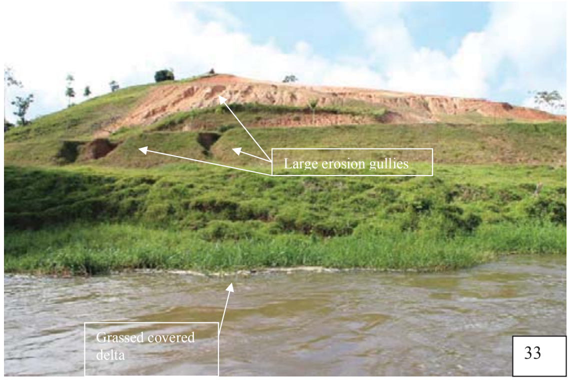

103c


105

3. Accelerated fluvial erosion processes (gullies): In the upper RSJ above the Rio San Carlos, fluvial erosion processes along Route 1856 have been astronomically accelerated over background natural gully erosion rates. Gullies, rare in the natural, undisturbed tropical landscape, are nearly ubiquitous on both cut- and fillslopes, as well as on bare soil areas exhibiting any slope steepness. The lack of any planning, design, construction and maintenance standards for the road is resulting in widespread erosion that is displacing tens of thousands of cubic meters of soil, and given the close proximity of the road to the river, delivering a significant portion of the transported sediment to the Rio San Juan. Most of the gullies erosion is associated with poorly constructed and compacted fills, constructing over-steepened cutbanks, poorly designed road surface drainage, and lack of any efforts to maintain the road post-seasonal construction activities.


3

27b



33

34


39

42


56


64e


68


71


77


118b

4. Lack of compaction and fill failures: The following photos illustrate the widespread extent of fill failures along Route 1856 within the upper RSJ above Rio San Carlos. Utilized archaic "cut and fill and sidecasting" road construction methods on steep hillslopes in such close proximity to waterbodies displays a total disregard of well-established water quality and environmental protection principles. The lack of any design or construction standard on the preponderance of steep hillslopes present within the upper portions of the RSJ is resulting in significant accelerated erosion and sediment delivery to the Rio San Juan at most of these locations. Without immediate efforts to stabilize these failing fillslopes, (i.e.utilizing excavators to retrieve all the failing fills and creating a "full bench" road), ongoing erosion and sedimentation impacts will continue to occur at extreme rates.


59

64b

70b


74


75


78b


83

88a


95d


109


119b

5. Sedimentation photo suites: The following individual photos and photo suites document current conditions at several dozen Costa Rican tributary stream/gully confluences along the south banks of the Rio San Juan. Almost all the observed confluences exhibited evidence of varying degrees of recent, active and/or ongoing sediment transport into the RSJ. Visual sedimentation effects ranged from thin veneers of silt- and clay- sized sediments deposited on and amongst stunted sedges and grasses, to the formation of coarse grained terraced outwash deltas and alluvial fans. Several of these outwash deltas extended up to 10 meters into the RSJ. Many observed tributaries were considerably more turbid than the main stem RSJ. These persistent cumulative impacts will continue to occur without an immediate extensive effort at conducting emergency erosion control, grade and slope stabilization, effectively dispersing road surface runoff, and re-routing many road segments farther from the RSJ.


4a


4b


4c


4d


18b


20


26a


26c


27a


27c


28


44


43a


43b


43c


43d


45


61

51a

51b

51c

58a

58b

80


65a


65b


66a


66b


Sediment delta
70b


84


76a


76b


76d


76e


81a


81b


85a


85b


87


88a


88b


88d


90a


90b


91a


91b


93a


93b


92


95e


97b


99


103d


106

118c

121b

6. Concentrated road runoff issues: The following photos along Route 1856 road segments in the RSJ above the mouth of the Rio San Carlos illustrate road design and construction methods that result in long lengths of "hydrologically connected" roads that will during every future rainfall and runoff event deliver sediment to nearby stream channels crossed by the road. The practice of designing and constructing: 1) flat or insloped road shapes with ditches and/or earthen berms along the outside edge of the road or 2) through-cut segments of road with cutbanks on both sides of the road (none shown in this section, see Section #7 for example photos on gentle hillslopes) should be avoided or minimized. Current BMPs in the Pacific Northwest emphasize dispersing road runoff rather than collecting and concentrating runoff along the road to protect water quality and minimize ongoing and future sediment transport and delivery to streams.


14


38


54


73


95c


104b

7. Road design/location to close to Rio San Juan: Two of the most effective professionally accepted standards to minimize the potential for water quality and habitat impacts associated with roads are: 1) utilize increased buffers and setbacks from waterbodies, and 2) avoid locating and constructing roads on steep slopes and on floodplains in close proximity to streams, rivers and wetlands. The following examples along the RSJ illustrate a total disregard for these widely accepted principles. Along the RSJ above the Rio San Carlos, we estimate 12.3 km (30%) of the 41.6 km road has been constructed within 50 meters of the southern bank of the Rio San Juan (i.e. the border), 28.3 km (68%) has been constructed within 100 meters of the RSJ, and only 5.7 km (14%) of the new road is located along a pre-existing, lower standard road bed (Tables 2, 3 and4). Given the observed extent of active and ongoing erosion along the road, future larger storms will continue to produce and deliver high sediment loads to the RSJ.


7


9


11


19


24


40


50a


64a


70a


82


86


95a


98


100b


102


112


119a


121a

8. Pioneered roads (non Route 1856) and other access roads to new developments: There are many additional newer pioneered road cuts and fills representing aborted Route 1856 alignments or that appear to have been constructed to augment new homes and other developments along the road. The following photos illustrate a few of these locations along the RSJ above the confluence with the Rio San Carlos. Most of these additional roads and activities have occurred within 50 or 100 meters from the border and river edge. As along most of Route 1856, there is little evidence of Costa Rican efforts to winterize or properly close the roads and to install interim erosion control measures to prevent additional sediment delivery to the Rio San Juan.


13


16


57


60b


67b


104a

APPENDIX C: Detailed Literature Review

Outline of Literature Summary

Literature Summary

> *The existing science on roads goes far in establishing what and where problems are likely to arise. More than half a century of research and experience supports (proper methods for) designing, building, and maintaining forest roads. Most of the major engineering problems associated with roads have been solved, and a wealth of information exists on many of the physical effects of roads, particularly on hydrologic and geomorphic watershed processes.*
>
> (Gucinski and others 2001)

Introduction

Roads have well-documented short- and long-term effects on the environment. This brief synthesis describes both the environmental consequences of road building, as well as the techniques that can either lead to improved environmental outcomes or serious environmental consequences, with examples from the scientific literature of the United States.

The scientific and engineering literature on forest roads in the United States is substantial and covers more than 60 years of research and practice. In North America, especially in the Pacific Northwest, the Rocky Mountains, the Appalachian Mountains and the coastal plain of the southeastern United States, research reports and papers have described road management practices and their environmental effects since the 1950s. As road practices and standards have evolved and improved, so too has the science of roads and their effect on the environment.

Modern road design and construction standards are greatly improved compared to those practiced even 30 years ago, and reflect both our increased understanding of the geomorphic and hydrologic effects of roads, as well as the improved equipment and methods that are now routinely employed in road planning and building (e.g., EPA 1975, Swift 1985). These methods, whether developed in the tropics or in semi-tropical and wet temperate environments, have generally been employed and practiced around the world (e.g., Larse 1971, Haanshus 1998, Spinelli and Marchi 1998, Aulerich 1998).

In public wildland development and forestland management, road systems represent the largest human investment as well as the single most potentially damaging land management activity, if done carelessly or incorrectly (Gucinski and others 2001, Reid and others 1997, Furniss and other 1991, Swift 1985, Spinelli and Marchi 1998). The choices that are made regarding the location, length, type, and nature (design) of the road have financial, social and ecological implications (Larse 1971, Aulerich 1998). Roads have well documented short term and long term effects on the environment that can be classified into 2 categories: beneficial and adverse (Gucinski and others 2001). The most apparent group of beneficial effects is related to access and consequent economic development, while significant adverse effects are usually related to altered geomorphic and hydrologic processes (runoff, erosion, sedimentation, and pollution), human dislocation, habitat fragmentation, and a variety of direct and indirect ecologic consequences associated with subsequent land development and management (Reid and others 1997).

Lessons from evolving forest road standards in the United States

In both the Pacific Northwest (marine wet temperate) and Southern Appalachian Mountains (humid subtropical) of the United States, where much of what we have learned about solving problems with forest roads originates, there now exists more than 60 years of published record in the evolving methods of public and private land forest road planning, design, and construction in various environments. Not only is there a long and well-published record of the evolving standards and methods for all phases of forest road building, there also exists a substantial record of the causes and effects of the consequent geomorphic and ecological impacts attributed to the various strategies and practices that have been employed. While well supported by field, small watershed, and plot studies, as well as by retrospective studies at the broader landscape level, the specific effects of road construction at a given location or along a continuous road alignment are also strongly influenced by local factors, including road location, road building techniques, soil and geology, precipitation and runoff regimes, and topography (McCashion and Rice 1983, Swanson and others 2000).

One of the clear lessons derived from the long history of land management activities in forested areas of the western and southeastern United States is that roads are clearly one of the most impacting land use activities that occurs in developing and managing the wildland landscape (Gucinski and others 2001, EPA 1975, Furniss and others 1991, Larse 1971, Swanson and others 2000). The impacts of road construction vary with the type of planning (location), design, and construction standards that are employed, as well as the continuing use levels, maintenance, and erosion control activities that occur in the years following initial road building (Furniss and others 1991, McCashion and Rice 1983, Kochenderfer 1970, Swift 1985, Aulerich 1998). Finally, subsequent large storms then "test" these poor design and construction methods and trigger widespread failure, erosion and sedimentation, and degradation of the receiving streams and rivers (Hagans and others 1986, Copestead and Johansen 1998, Doyle and Ketcheson 2007, Furniss and others 1998). For example, in response to the regionally intense, 100-year storm and flood event that occurred in 1964, streams and large rivers in northern California suffered massive sedimentation and channel filling that is still expected to persist for many decades into the future. These once-productive main stem rivers remain heavily impacted and now support greatly diminished runs of anadromous salmon. Similar impacts occurred regionally in response to the flood event of 1997 in Washington, Oregon, and Northern California (Furniss and others 1991, Copestead and Johansen 1998, Doyle and Ketcheson 2007, Furniss and others 1998).

The following two sections describing the erosional and hydrological effects of forest road building are largely drawn from the literature of road building and scientific studies in mountainous areas of the Pacific Northwest, the southern Appalachians and the forested piedmont of the United States. These findings and study results are informative because they reflect the important role that evolving design and construction standards have had in diminishing the environmental impact of road building, road upgrading and road management in the forested environment. Further, they exemplify how improving standards, and the scientific studies that have accompanied these improving practices, have pointed the way to more protective best management practices that lessen environmental impacts while resulting in transportation systems that require less maintenance, are more resilient, and have fewer adverse on-site and off-site ecological impacts (EPA 1975, Furniss and others 1991, Weaver and others 1994, Swanson and others 2000).

Erosional impacts of forest roads

Forest roads have both geomorphic and hydrologic effects on the landscape through which they pass. These range from long term increases in surface runoff and chronic fine sediment erosion to mass failures of road cuts and fills.

The *geomorphic effects* of forest road construction range from increases in surface erosion and chronic fine sediment delivery from bare soil areas exposed during and following construction, including the new road bed and adjacent cuts and fills, to catastrophic mass failures of road fills and cutslopes (road-related landslides) and failures of poorly designed, constructed or maintained stream crossings (Murphy 1995, Hagans and others 1986, Copestead and Johansen 1998, Furniss and others 1998, Spinelli and Marchi 1998, Swanson and Dyrness, 1975).

<u>Mass wasting</u> - Where roads cross steeplands, road building increases landsliding, including slumps, debris slides and more fluid debris flows (Amaranthus and others 1985, Rice and Lewis 1986, Gucinski and others 2001, Mersereau and Dyrness 1972, Murphy 1995). In steep forested areas, mass erosion rates of 30 to 300 times the rate of undisturbed forest lands have been found to occur with road construction, with the rate of increase greater in areas of steep topography, unstable geology/soil, wet climates and

where poor road location, design, and construction methods have been employed (Gucinski and others 2001, Furniss and others 1991, McCashion and Rice 1983, Mersereau and Dyrness 1972, Murphy 1995). Amaranthus and others (1985) found erosion rates on roads and landings to be 100 times greater than on undisturbed forest slopes in the Klamath Mountains of southwestern Oregon. The magnitude of mass wasting along new road alignments is dependent on the climate, geology, soil erodibility and stability, slope steepness, soil moisture, as well as road location, design standards and construction practices (McCashion and Rice 1983).

Mass wasting is usually not a significant source of post-construction erosion and sedimentation where slopes are gentle or moderate and stable, or where endhauling techniques are employed during road construction. Endhauling involves excavating the new roadbed and using dump trucks to haul away the excavated spoil materials to stable spoil disposal sites far away from streams and rivers. In contrast, landsliding of unstable fillslopes becomes common and potentially catastrophic where roads built across steep slopes are built using sidecast construction methods, with bulldozers creating the road cut and pushing the loose, uncompacted spoil materials on the steep slopes below the road (Mersereau and Dyrness 1972, Murphy 1995). It is commonly the case that erosion and sedimentation due to road-related landsliding is spatially discrete, with a relatively small amount of the new road length responsible for contributing a large proportion of the landsliding and resultant downstream/downslope sedimentation. For example, major erosional features occupied only 0.6 percent of the length of roads studied by Rice and Lewis (1986) in the northern California coastal mountains.

Mass failures are most frequently associated with improper placement and compaction of road fills, especially where roads are built across steep slopes, and by deep cutting into the steep, potentially unstable hillsides during construction. They are also triggered by poor road siting (e.g., constructing the road across naturally unstable slopes or erodible soils), and where surface or subsurface drainage has been collected or diverted onto loose fills. If receiving waters (streams, rivers or lakes) are in close proximity to the road, these mass wasting process can directly deliver large volumes of sediment to downstream areas and result in significant ecological damage and alteration of the natural stream channels. Gullying of steep road cuts and fills, caused by collecting and concentrating direct rainfall and runoff on the bare soil areas along the newly constructed road, are also a common source of accelerated erosion and downslope/downstream sedimentation.

<u>Stream crossing failures</u> – Roads interact directly with stream channels in a variety of ways, depending on the location, proximity, and orientation of the road relative to the stream or river. Road-stream crossings are considered one of the most vulnerable and sensitive parts of a road system; being subject to floods, high stream flows, high sediment loads, and woody debris in transport that can cause the design capacity of the crossing structure to be exceeded. (Furniss and others 1998, Weaver and others 1995). Once exceeded, the crossing is subject to partial or complete failure and washout (erosion) and then the entire volume of eroded sediment is transported downstream. The impacts may be direct, as where erosion from the road is delivered directly to the stream or river, or indirect, where erosion and sediment delivery originates upstream and then impacts off-site downstream aquatic habitat and channel processes (USDA Forest Service 1999).

Roads like Route 1856 that are constructed on floodplains, in riparian zones or on lower hillslopes in close proximity and parallel to mainstem channels of large streams and rivers may have the most direct impact on channel morphology and water quality (LaFayette and others 1993, Swanson and others 2000). Erosion that occurs in these alignments requires minimal sediment transport distances to reach the waterbody. Roads that cross mainstem or tributary stream channels require the design and construction of road-stream crossings that are resilient to failure during storm and flood events (Furniss and others 1997, Weaver and others 1995). This practice is referred to as storm-proofing or "constructing a hydrologically invisible road," where the road does not act to divert natural flow paths (Weaver and Hagans 1999, Doyle and Ketcheson 2007). Poorly designed or constructed road-stream crossings, including culverts and bridges, account for regionally significant watershed erosion and sediment delivery, and consequent channel aggradation and damage to downstream channel morphology, aquatic habitat, and water quality (Murphy 1995, USDA Forest Service 1999, Madej and Ozaki, 2009). These indirect storm-caused impacts of road-stream crossing failures include increased erosion and sedimentation rates, off-site changes in channel morphology, and aquatic habitat degradation (Gucinski and others 2001, Harr and Nichols 1993, Hagans and others 1986).

Post-flood studies in the Pacific Northwest of the United States reveals the importance of designing roads to accommodate comparatively infrequent, large magnitude storm and flood events in order to lessen both the probability and magnitude of consequent erosion and downstream sedimentation caused by road-stream crossing failures (Furniss and others 1997, Copestead and Johansen 1998, Doyle and Ketcheson 2007, Furniss and others 1998, Weaver and others 1995, Weaver and Hagans 1999). Road-stream crossings, which are implicated in many documented road failures in the Pacific Northwest (Furniss and others 1998), have been the focus of research and improved road design and construction practices over the last three decades. Under-designed or poorly built culverted stream crossings are highly vulnerable to plugging and overtopping; processes which frequently result in catastrophic washouts, fillslope erosion, stream diversion and consequent gully development, and downstream sedimentation (Furniss and others 1998, Murphy 1995, Weaver and others 1995). Culvert plugging and overtopping and subsequent stream diversion onto adjacent unprotected hillslopes is recognized as one of the most significant and damaging forest road impacts that occur during storm events (Weaver and others 1995, Furniss and others 1998). In addition, poorly located and designed bridges are also susceptible to washout during flood events if their abutments cause channel constriction or if their height above the stream bed is insufficient to allow for design flood flows, sediment and woody debris in transport, and the backwater from adjacent rivers (Doyle and Ketcheson 2007).

<u>Surface erosion</u> – Surface erosion occurs wherever there is bare, exposed soil that is subjected to rainfall. Rainfall dislodges soil particles and surface runoff both causes erosion and transports the eroded soil to downslope and off-site areas, including stream channels. Surface erosion on newly constructed roads occurs on bare fillslopes and cutslopes, as well as on the road surfaces and within roadside ditches, and can represent a significant or even dominant source of road-related sediment input to nearby streams. Surface erosion on roads has been well documented in the literature of the western (Bilby and others 1989, Donald and others 1996, Megahan and Kidd 1972, Reid and Dunne

1984, Rothacher 1971, Sullivan and Duncan 1981) and eastern United States (Kochenderfer and others 1997, Swift 1985, 1988).

Surface erosion products consist of mostly fine-grained sized sediments that are eroded by raindrop impact and Hortonian overland flow (often called sheetwash erosion) and transported from road surfaces, cutbanks and ditches to nearby streams. Rates of surface erosion are typically highest during and for the first few years following road construction when soils are most exposed (Megahan and Kidd 1972, Megahan 1974, Burroughs and King 1989, (Mercereau and Dyrness 1972, Washington Department of Natural Resources 2011), but are also highly correlated to the volume and type of road traffic that occurs subsequently on both rocked and native surfaced roads (Reid and Dunne 1984, Sullivan and Duncan 1981). Surface erosion is highest where the bedrock is highly fractured and weathered, and where soils are granular and low in rock fragments and clay content. Connectivity and consequent sediment delivery occurs wherever road runoff has a direct path from the area of erosion, through the point of discharge on the road, to a nearby stream; such paths may be ditches, road surface drainage structures (e.g., ditch relief culverts), rills, gullies or any other path where storm runoff is delivered (Wemple 1994, Wemple and others 1996). The closer a road is to a stream or river, or the higher the density of road-stream crossings, the greater the hydrologic connectivity and likelihood of surface runoff and eroded sediment being delivered directly to the adjacent waterbody (Wemple and others 1996).

<u>Magnitude and timing of road erosion</u> - The magnitude of erosion during or following road construction is a function of a variety of factors, including climate, the timing and intensity of post-construction rain and flood events, the geologic stability and erodibility of soils, landscape topography, stream crossing density, as well as the layout, location, and design standards of the road; and construction practices that are employed (McCashion and Rice 1983, Swanson and others 2000, Swift 1985, Ziemer and Lisle 1992). Roads built with little or no adherence to proper planning (location) or engineering designs, or those that employ careless construction methods, including excessive ground disturbance or deep cuts on steep, potentially unstable hillslopes, are most likely to result in high rates of post-construction mass wasting (landslides), fluvial (gully) and surface (rill and sheetwash) erosion (Kochenderfer 1970, Murphy 1995, Aulerich 1998).

Road-related impacts also vary over time (Ziemer and Lisle 1992). Some impacts occur immediately, or as soon as the first rains fall on the newly exposed road cuts and fills. For example, surface erosion from bare soil areas will occur as soon as the first rainfall and runoff event affects the construction site (USDA Forest Service 1999). These rains generate short term, but persistent and chronic impacts that will affect the road corridor as long as there is bare soil. Surface erosion occurs with every runoff event and its magnitude is dependent on the duration and intensity of rainfall. Over decades, and in some environments, the volume of eroded sediment contributed by surface erosion processes (raindrop erosion, sheetwash and rilling) can equal or exceed that contributed by more visually apparent slope failure and gully erosion processes (Murphy 1995). The degree of connectivity between a road and the streams through which it passes is one measure of the degree of potential long term impact from surface erosion that can be attributed to road construction and maintenance over time (Wemple and others 1996). The more the road system is hydrologically connected or draining to streams through which it passes, the greater the potential for long term, chronic sedimentation and downstream, off-site biological impacts (Wemple 1994).

In contrast to chronic surface erosion, episodic erosion processes and downstream impacts may not occur until the site experiences a significant external event such as a heavy rain or flood that triggers slope failures, culvert plugging, and gully development (Weaver and others 1995, Furniss and others 1998, Murphy 1995). For example, if stream crossings along the road were built with poorly designed, undersized or improperly installed drainage structures (e.g., culverts), these stream crossings will be likely to fail during a future flood event that exceeds their capacity. In the Pacific Northwest, stream crossing design standards for forest roads have increased through the decades. From the 1940s through the mid-1970s, there were few design standards for road construction and equipment operators did whatever was easiest and least costly. Similar practices occurred in the southeastern United States (Swift 1985). Where they have not yet been upgraded to current standards, these roads have continued to experience high rates of erosion and stream crossing failure and the affected watersheds may not attain a steady state of erosion for a century or more (Ziemer and Lisle 1992). Beginning 35 years ago, California forest land regulations required forestland stream crossings be designed to accommodate a minimum 25-year recurrence interval peak flood flow. In the early 1990s, this design standard was increased to a 50-year flood flow and by 2000, both state and federal agencies throughout forested lands in the Pacific Northwest were required to design stream crossings to pass the 100-year design flood flow. These evolving design standards were adopted to reduce the frequency of road failures and the magnitude of watershed erosion and downstream impacts to aquatic habitat (USDA Forest Service 1999).

Some features along a road will also degrade over time and may continue to cause erosion, slope failure, and off-site sediment delivery for years or decades after initial construction (Ziemer and Lisle 1992). For example, delayed failures and impacts can occur where road fills were built or placed by sidecasting onto steep slopes without using proper compaction methods or efforts, where the steep ground surface was not properly grubbed and scraped clean of organic matter prior to fill placement, or where organic debris was incorporated into the fill material as it was placed. These compromised road fills and fillslopes are subject to episodic instability and failure during wet weather storm events as the loosely placed spoil materials become saturated, settle and adjust on the steepened slopes, and the wood and organic matter decays and provides weakened interior slip surfaces. Fillslope failures on poorly constructed forest roads built on steep slopes in the Pacific Northwest continue to show instability and fail many decades after their initial construction. Large magnitude winter storms that trigger widespread fillslope failures and debris slides along forest road systems have caused extensive off-site channel aggradation and damage to aquatic habitat (USDA Forest Service 1999, Madej 1995, Nolan and Marron 1995, Pitlick 1995, Ziemer and Lisle 1992, Madej and Ozaki 2009).

The ecological effects of increased road-related erosion and sedimentation, whether from chronic or episodic sediment sources, are thought to be widespread and may affect streams and rivers far downstream (USDA Forest Service 1999). Widespread failures of road cutbanks, fillslopes and stream crossings during flood events may cause massive downstream sedimentation and result in widespread, persistent channel bed aggradation, filling, loss of navigation, and damage to aquatic life (Madej and Ozaki 2009). Chronic sediment delivery can be detrimental to aquatic life that depends on water clarity for feeding and streambeds that are aerated and unimpacted by fine sediment (Megahan 1977). The additive nature of these individual on-site road erosion processes and erosion features, coupled with the consequent changes/impacts to off-site physical and hydrologic processes and biological resources, are referred to as "*cumulative effects*" (Ziemer and others 1991, Reid 1993). Roads that exhibit extensive and persistent on-site erosion following construction are very likely to be resulting in significant off-site cumulative watershed effects to both channel morphology, as well as aquatic biology (Swanson and others 2000, Ziemer and Lisle 1992, Cederholm and others 1981).

Hydrologic impacts of forest road construction
The *hydrologic effects* of forest road construction have been less well studied and only within the last several decades have the importance of those interactions become apparent. Most engineering studies have emphasized traditional geotechnical issues related to water on roads, including road drainage design, subsurface drainage techniques, culvert sizing and placement, and erosion control from road surfaces (Keller and Sherar 2003, Swift 1988). Small watershed studies including some component of forest road hydrology include those by Rothacher (1965, 1970, 1971, 1973), Harr and others (1979), Jones and Grant (1996), and Thomas and Megahan (1998) in western Oregon; Ziemer (1981, 1998) and Wright and others (1990) in northern California; King and Tennyson (1984) in central Idaho; Reinhart and others (1963), Hewlett and Helvey (1970), Swank and others (1982, 1988) in the southern Appalachians, Helvey and Kochenderfer (1988) in the central Appalachians; and Hornbeck (1973) and Hornbeck and others (1997) in the northern Appalachians (Gucinski and others 2001).

More recent studies have focused on how roads affect the hillslope hydrology by diverting and increasing surface runoff, streamflow and fine sediment pollution through hydrologic connectivity, and how roads act to divert streamflow during infrequent, large magnitude flood events when culverts and other drainage structures become plugged (Furniss and others 1998, Weaver and others 1995, Murphy 1995). The hydrologic effect of roads on a landscape include increased interception of rainfall and emergent groundwater wherever the road has been cut into the native hillside and now intercepts soil water throughflow and local groundwater. Increased surface runoff generated from bare road cuts and compacted road surfaces is collected, concentrated and diverted onto uncompacted road fills and adjacent native hillslopes where it may cause erosion and gullying of erodible soil materials.

Where roads cross natural stream channels the crossing sites are especially vulnerable to failure during flood events and streamflow can either washout the road or divert onto the adjacent, unprotected hillslope where massive gullying and soil loss is possible. Recent studies after large floods in the Pacific Northwest highlight the importance of water diversion by roads and road-related structures when culverts and ditches plug and diverted flow contributes to road-related failures (Donald and others 1996, Furniss and others 1997). Cascading failures, where diversion or concentration of stream or ditch flow at one location led to a series of other erosional events downslope, ultimately resulted in loss of one or more roads or initiation of hillslope landslides and debris flows (Gucinski and others 2001, Weaver and others 1995, Furniss and others 1998).

Redwood National Park – A World Heritage Site example
The geomorphic and hydrologic impacts of forest road construction have previously been described in the context of evolving design and construction standards in the United States. Forest management and road construction practices in the Redwood Creek basin of northern California, United States, mirror those elsewhere in the Pacific Northwest and have been uniquely accompanied by extensive research regarding the impacts and effects of forest and road management on rivers and streams. In this context, Redwood Creek provides a relevant case example of the on-site impacts of road building and its potential physical and ecological cumulative effects in off-site, downstream areas.

In 1850, old-growth redwood forests covered more than 8,100 km^2 (3,100 mi^2) of the northern California coast. Some of the world's tallest living trees were located in the 725 km^2 (280 mi^2) Redwood Creek watershed north of Eureka, California. Prior to 1968, most of the Redwood Creek watershed was privately owned and managed for timber and forest products. Road construction and logging of old growth redwood and Douglas-fir forests in the watershed accelerated after World War II and during the economic boom of the 1950s and 1960s and continued unabated, with little regard to design standards or environmental consequences (Best 1995). By the 1960s the lower main stem channel of Redwood Creek had locally aggraded with up to 5 meters of sediment derived largely from poor road building and logging practices in the upstream watershed areas (Janda and others 1975, Madej 1995, Madej and Ozaki 2009). Continued aggradation and bank erosion was threatening to kill the world-renown old growth redwood groves along the Redwood Creek channel.

It wasn't until 1968 that Redwood National Park was established by an act of the U.S. Congress, largely in response to the immediate threats to the world's tallest trees growing along its streambanks in the lower watershed (Agee 1980). In 1978, Congress added another 195 km^2 (75 mi^2) of forest land for additional watershed protection that included both logged and unlogged portions of the Redwood Creek watershed. As a part of this protective legislation, Congress also provided funding for a 20-year, multimillion dollar program to control the high rates of erosion and to conduct research to better understand the relationship between land use practices, effects on erosion processes, and watershed-wide impacts. Today, these lands are undergoing large-scale restoration by the Park's resource managers. In recognition of its rare ecosystem and cultural history, the United Nations designated the Park as a World Heritage Site on September 5, 1980, and an International Biosphere Reserve on June 30, 1983.

Research into the causes of widespread channel aggradation and exceptionally high rates of erosion in the Redwood Creek watershed were conducted by the U.S. Geological Survey (USGS), the research arm of the U.S. Department of the Interior, and other university and federal researchers. Some of these studies were reported in USGS Professional Paper 1454, published in 1995. For example, significant increases in sediment yield and runoff caused by ground disruption and road construction associated with timber harvesting have been documented by Marron and others (1995), Weaver and others (1995), Nolan and Janda (1995), and Best and others (1995). Redwood Creek became a living laboratory for research on the geomorphic and ecological effects of logging and road building in steep forest lands of the United States (Nolan and others 1995), and later for its internationally acclaimed program to restore and rehabilitate the heavily degraded and disturbed landscape (Coates, 1981, Madej 2001). The lessons learned at Redwood National Park and in the Redwood Creek watershed have served to establish and guide more progressive land use practices and watershed protection in other parts of the United States and around the world.

Many of the Redwood Creek research projects conducted from the 1970s through the present have focused on road building practices and their impacts on geomorphic processes and erosion rates. For example, studies identified, for the first time in the scientific literature, that the persistent, widespread geomorphic effects identified in stream and river channels, characterized by channel aggradation and bank erosion, are significantly attributed to poor road construction and land management practices in upstream areas (Hagans and others 1986). At least 40 percent of the erosion and sedimentation in the period 1947 to 1980, a period characterized by widespread timber harvesting and the construction of 2,000 km of forest road with few controlling standards or regulations, was found to be associated with stream diversions at logging road and skid trail stream crossings. Hillslope erosion and downstream sediment accumulations in the main stem river channel were triggered by large magnitude storms and flood events, and the introduced sediments are thought to have residence times of decades to centuries based on present rates of channel recovery (Madej 1995).

A number of relevant conclusions have been drawn from the geomorphic research conducted in Redwood Creek, and especially those related to the off-site impacts of road construction and ground disruption on the landscape and the downstream river system.

- Disruptive land use practices, especially road construction on steep slopes, have caused persistent geomorphic effects at the land use site, on downslope areas, and in far removed stream channels. These effects are cumulative and include on-site increases in drainage density and channel dimensions, off-site, downslope increases in fluvial erosion rates, drainage density and stream channel dimensions, and off-site, downstream increases in the volume of stored sediment and incidence of bank erosion, as well as decreases in pool volume and number (Hagans and others 1986).
- Little attention was paid to potential impacts of poor road location and topographic setting during road building in the watershed. Roads were built across steep slopes, unstable areas, erodible soils and close to and within stream channels. These practices subsequently resulted in widespread slope failure and high rates of erosion during subsequent winter periods and in response to large storm events (Janda and others 1975, Best 1995).
- Persistent cumulative effects of erosion and sedimentation measured in Redwood Creek are a direct result of land use practices conducted during a period of little land use regulation. Low gradient main stem river and tributary stream channels were the repository for sediment eroded from steep hillslopes and upstream areas, and these channels are expected to require decades to centuries to cleanse themselves and recover from aggradation (Madej and Ozaki 1996, Pitlick 1995, Madej 1995, Nolan and Marron 1995).
- The most significant periods of erosion and off-site, downstream impacts from landslides and road failures occurred during relatively short lived, large magnitude storms and floods that followed periods of intensive land use and road building (Harden 1995, Nolan and Marron 1995). These climatic events triggered watershed-wide geomorphic responses to previous land management and to

poorly located, designed and constructed forest roads that had been built in previous periods.

- Past road building practices continue to significantly affect fluvial erosion rates, lower order and main stem channel geometry, drainage densities, streambed structure, and the volume and residence time of stored sediment. Old roads that have not been upgraded or removed continue to fail during winter storm, decades after their construction (Madej 2001).
- Gully erosion from failed stream crossings represents a significant source of erosion and sediment yield from roaded and logged hillslopes in the Redwood Creek watershed. Plugged culverts, failure to install culverts at logging-road stream crossings, and bulldozing of soil and logging slash into shallow hillslope stream channels were the leading causes of stream diversions and consequent gullying. Most gully erosion occurred in certain high-yield terrain types, of restricted aerial extent, which were characterized by thick, erodible soils deficient in rock fragment and clay content (Weaver and others 1995).
- The greatest volume of road-related erosion and sediment delivery originated at stream crossings with undersized culverts, or poorly designed culverts that were subject to plugging, which also exhibited a diversion potential. When culverts plugged and streamflow was diverted down the road or across adjacent unprotected hillslopes, they generated large volumes of erosion and downstream sediment delivery (Hagans and Weaver 1987, Weaver and others 1995, see also Furniss and others 1998).
- The landscape within the Redwood Creek basin is particularly sensitive not only because ground disruption associated with road building and land management can easily increase erosion at a specific location but also because such increases can affect areas downslope and downstream, and such off-site impacts are both significant and persistent (long term) (Nolan and others 1995).
- Data from hillslopes in Redwood Creek clearly illustrate how past and present land use practices have "primed" the logged watersheds for additional, future erosional events and subsequent drainage basin response (Hagans and Weaver 1987, Hagans and others, 1986).
- Subsequent watershed restoration in the Redwood Creek basin has been conducted continuously since 1978 on lands previously logged and roaded by private timber companies. Over $40,000,000 has been expended to reduce erosion and sedimentation rates and to restore geomorphic processes on Park lands alone, and additional millions of dollars have been expended on private and public lands in upstream areas. Watershed restoration and erosion control on logging road has been effective, but expensive (Fay and others 2012, Weaver and Hagans 1996, 1999, 2006; Madej 2001).
- Almost all watershed restoration in the Redwood Creek watershed has been focused on treating active and abandoned forest roads, as they have been identified as the most threatening and potentially preventable sources of future accelerated erosion and sedimentation in the basin. Most treatments have involved road closure and road decommissioning in which potential and existing sediment sources are permanently treated or eliminated (Weaver and Hagans 1999, Weaver and others 2006, Madej 2001).
- Watershed restoration, erosion prevention, and road rehabilitation practices developed in the Redwood Creek watershed have now been routinely deployed

throughout forested lands in the Pacific Northwest. The greatest emphasis on both public and private forest lands has been to decommission and remove roads that were built in unstable, erodible or high hazard geomorphic settings (such as steep streamside locations), so as to prevent catastrophic failures and sediment inputs to streams and rivers during large magnitude, infrequent storm and flood events.

- The second regional emphasis for road restoration and watershed protection in the Pacific Northwest over the last decade has been to "storm proof" existing forest roads that are to be retained for continued forest management and public access (Weaver and Hagans 1994, 1999; Weaver and others 2006). Storm proofing consists of upgrading old forest roads to current design standards that are considered sufficient to provide protection to downstream aquatic habitat for both chronic and episodic sources of erosion and sedimentation. New roads are always planned, designed and constructed to high standards required by Best Management Practices, but pre-existing roads are now either being decommissioned or brought up to current standards through the process of storm-proofing and upgrading.

Best management practices: minimizing impacts from forest road construction

> *It is much better to have a bad road in a good location than it is to have a good road in a bad location. A bad road can be fixed. A bad location cannot.*
>
> Keller and Sherar (2003)

There are a number of ways forest road construction can occur while providing maximum protection to the physical environment through which the road passes and to the adjacent and downstream areas that might otherwise be adversely affected by road construction and the long term presence of the road (EPA 1975, Furniss and others 1991, LaFayette and others 1993, Megahan 1977, Moll 1993, Swift 1985, Ziemer and Lisle 1992). A variety of basic planning, design, and construction standards are employed to minimize the potential environmental impacts of a newly constructed or rebuilt forest road; each of which affects post-construction erosion rates, mass wasting, sediment delivery to streams, and the level of downstream off-site physical and biological impacts (Kochenderfer 1970, Megahan 1977, Moll 1993, Swift 1985). Practical field observations and scientific studies often point to similar solutions to the most common and significant road-related environmental problems that typically surround road construction and road management activities (LaFayette and others 1993).

Current, comparatively protective standards for road location, design and construction are found throughout the technical literature as planning practices, design manuals, construction standards, and maintenance manuals (e.g., EPA 1975, Keller and Sherar 2003, Weaver and others 1994, Furniss and others 1991, Kochenderfer 1970). They are the focus and outcome of practicing professionals in the engineering, geological, and biological sciences (Larse 1971, Aulerich 1998). Most federal and regional governments adhere to these "best standards" and require their practicing professional engineers and scientists to meet these industry standards. They mark the state of the profession and they represent the current standards for "best management practices" (BMP) (Murphy 1995). Practices formally change and become the new standard when new data is available, findings have been confirmed and proposed changes in practice have been vetted through the professional and regulatory community. Improved practices often evolve in response to scientific and ecological assessments of the impacts of then-current or past practices or as new, improved products are tested and brought to the field by the construction industry. They are sometimes developed or refined in response to environmental damage to ecological systems, habitat and endangered species, or in response to changing public attitudes and regulatory pressures.

Environmental analysis - Perhaps the single most important concept in developing low impact transportation systems is preparation of an interdisciplinary environmental analysis, in which various alternatives for road location, design and construction standards are explored, compared and evaluated, and the environmental consequences of the alternatives have been analyzed (Moll 1993). This step naturally precedes any earthmoving activities. It is a thoughtful and consultative process designed to result in the best fit of the road to the environment, the terrain, and the community which it will serve. Keller and Sherar (2003) outline an eight step environmental analysis process that takes the project from identification through scoping, data collection, design, impact analysis, review of alternatives, public review and decision, and implementation (construction). Depending where it occurs, this process is often required by law and is intended to produce sound plans, good decisions, and a cost-effective low impact road (Moll 1993).

Planning - Road planning and analysis is undertaken to ensure that the road will meet the needs of its current and future users and that it can be built while minimizing adverse effects on the environment (Kochenderfer 1970). Road building guides, manuals and standards employed throughout the industry largely adhere to similar principles to protect the environment during road construction and related road management activities. Roads are located to minimize ground disturbance and avoid environmentally sensitive or potentially unstable terrain. Wherever possible, they follow the contours rather than cut across the landscape. Steep slopes are avoided wherever possible, as are wetlands, riparian zones, floodplains, waterbodies and other problem sites and obstacles.

Roads should be located to minimize the number of stream crossings and to stay as far away from rivers, streams and lakes as possible by utilizing broad, heavily vegetated buffer strips anytime they must come in close proximity (Murphy 1995, Barling and Moore 1994). The most common buffer widths for preventing sediment movement to watercourses is 30 meters, but distances depend on sites factors including geology, slope, vegetative cover, and precipitation (climate). Protection from runoff in humid tropical areas, where rainfall and surface runoff from disturbed areas is high, would likely require greater buffer widths. Filter strips are most effective when the flow is shallow, slow and enters the strip uniformly along its length. In steeper terrain, where flow is more likely to collect and discharge in concentrated volumes through swales or gullies, the greater velocities and larger flow depths can rapidly submerge the vegetation and significantly reduce the effectiveness of the filter strip (Barling and Moore 1994).

Design and construction - There are too many design and construction engineering standards for forest land and public land road systems to describe in detail in this brief review, but a few of the most relevant and important in this setting are included here. Slight variants of these basic measures are employed in various climates and terrains and their origin and use is typically supported by published scientific literature and field tests. These measures and standards are well known and accepted, and are well documented in published technical literature, BMP manuals, regulatory standards and trade journals, and are considered standard operating procedures and best-practices e.g., EPA 1975, Moll 1993). Proper design and construction control is mandatory for new roads that are to have the minimum possible effect on the environment (Aulerich 1998).

They consist of standard engineering concepts for road cuts and fills, stream crossings, and road surface drainage, as well as post-construction erosion control measures, that are intended to protect roadbed integrity and minimize on-site erosion and off-site impacts (e.g., Swift 1985, Fay and others 2012). If diligently and correctly employed, BMPs for forest road design will result in the construction of cost-effective, low impact roads with reduced storm damage and maintenance requirements (Moll 1993, Swanson and others 2000). Responsible, professional engineers and geologists should visit construction sites in the field during both the design and construction phases of a project to ensure that there are adequate inspectors and quality control testing during construction (Aulerich 1998).

Protective road design and construction standards and best management practices for new and reconstructed roads should include at least the following measures (see e.g., Keller and Sherar 2000 and 2003, EPA 1975, Furniss and others 1991, Weaver and Hagans 1994, Murphy 1995, Fay and others 2012):

<u>Cuts and fills:</u>

- Designs for new or reconstructed roads are developed using standard plans and specifications, and they are implemented (constructed) under professional oversight and control. Detailed technical drawings are developed for specific problem sites and road reaches requiring engineering expertise along the proposed right-of-way;
- Road clearing, the area of soil disturbance opened during construction, and road surface width are all strictly minimized. The amount of disturbed ground open at any one time does not exceed that which can be stabilized and protected against erosion prior to the occurrence of erosive rainfall;
- Road alignments should avoid steep ground (>35% to 50%) where lower slope alternatives are available;
- Road embankments and subgrade materials are properly stabilized and compacted during their placement using standard engineering compaction methods and effort;
- Balanced cut and fill construction techniques are employed on moderate terrain while full bench endhaul construction techniques are used when traversing slopes exceeding 50%, especially where sidecasting of spoil could result in slope failures, high rates of erosion, or sediment discharge to nearby streams or rivers;
- Excess spoil and excavated materials generated during road construction are endhauled by truck or otherwise disposed in locations far from waterbodies where erosion will be minimized and water quality and other resource values will not be adversely impacted; and
- Stable cut and fill slope angles are constructed with cut slopes at grades of 1:1 or flatter, and properly compacted fillslopes at 2:1 or flatter. Effective erosion control and rapid revegetation measures are applied to stabilize cut and fill slopes (e.g., Fay and others 2012).

Stream crossings and waterbodies:

- Avoid problematic or environmentally sensitive features such as wet and unstable areas and highly erodible soils;
- Avoid alteration of natural drainage patterns;
- Maintain an adequate distance or separation from rivers, streams and lakes (minimum 100 meters in steep and moderately steep, tropical terrain);
- Minimize the number of drainage crossings and eliminate stream "diversion potential" at all stream crossings;
- Design culverts and bridges that are large enough to span the ordinary high water width of flow (bankfull width) and culverted stream crossings with adequate peak flow capacity for design floods (recommended 100-yr peak flow);
- Construct stream crossings with clean fill and with stable compacted fillslopes around the culvert or bridge at either 2:1 slope angles or through the use of properly sized armor (rip-rap) or constructed headwalls;
- Never use wood or logs as drainage structures or incorporate woody material in any fill;
- Avoid encroaching on stream and river banks or constriction of the active (bankfull) stream channel width when crossing streams; and
- Design stream crossings to allow for fish passage at all life stages.

Drainage and erosion control:

- Minimize earthwork activities when soils are very wet or very dry or before oncoming storms. Time road construction activity and road use for the milder, drier seasons;
- Use slope stabilization measures, drainage structures, and road surface shaping as needed to prevent slope instability or to correct failures as soon as they are identified;
- Apply special techniques and soil stabilization BMPs when crossing wetlands, wet meadows, riparian areas, and streams;
- Provide effective, dispersed road surface drainage to avoid collecting and concentrating runoff than could result in excessive erosion and gullying of construction sites, fillslopes, road cuts and native hillsides;
- Minimize the number of "connections" between roads and watercourses by employing frequent cross-road drainage utilizing a combination of inboard ditch relief culverts, rolling dips, mildly outsloped road shaping, and berm breaches/cutouts along the outside edge of the road bed;
- Require a final erosion control plan (ECP) and interim erosion control measures during seasonal shutdowns. Stabilize all disturbed areas, work areas, spoil disposal sites, quarries, and temporary roads. Include typical drawings and specifications for seeding and mulching, sediment traps, silt fences, sediment barriers, biotechnical structures, and other erosion and sediment control measures;
- Reduce erosion by providing vegetative or physical ground cover on cuts, fills, drainage outlets and any bare, exposed or disturbed areas with any risk or potential for sediment delivery to nearby streams and watercourses;
- Provide filter strips or infiltration areas along the base of construction areas to trap sediment between drain outlets and adjacent waterways; and

- Perform adequate erosion control during and following construction activities, and prior to periods of extended shut down, to minimize erosion and prevent off-site transport of eroded soil.

Off-season inspections and maintenance:

- Provide thorough, periodic inspections and maintenance of all road cuts, fills, surface drainage structures, and road-stream crossing structures (culverts and bridges), as well as all erosion and sediment control measures along the road alignment. Maintain and repair any structures or features that are not functioning correctly or that could fail in a storm event, and add any additional measures that may be required to minimize erosion and prevent sediment delivery to streams or adjacent waterbodies;
- Identify and immediately correct any potential road failures, erosion sites or future sediment sources that could be triggered by normal rainfall or large magnitude storm events (hazard reduction inspections and treatments);
- Immediately correct identified ongoing erosion problems that are impacting water quality through the use of effective heavy equipment and/or labor intensive methods.

Long term project Best Management Practices:

- If and when serious hillslope stability problems are identified or develop along the road alignment, consider relocating that road section to a better, more stable location and fully decommissioning the abandoned, unstable route;
- If portions of a constructed road are located too close to the river, or too close to an ecologically sensitive waterbody or wetland, to prevent off-site impacts to those waters, those road sections should be considered for realignment to move them farther away. Once a road segment has been realigned, the abandoned sections should be fully decommissioned to eliminate the potential for future road failures and sediment delivery to streams;
- Effectively close, decommission, and restore all unused access roads, borrow sites, and construction areas as soon as they are no longer needed or being used. Any ancillary project sites or access routes that are to be retained for continued or future use should be storm-proofed and treated to minimize erosion and sediment delivery. Employ well documented, effective road decommissioning techniques, erosion control practices and hydrologic restoration techniques that will minimize erosion and eliminate the disturbed areas as future sediment sources.

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Soil erosion in the tropics with reference to the San Juan River basin

Throughout the world, soil erosion is the most destructive process degrading landscapes and delivering fine sediment to streams and rivers. In particular, humid tropical regions exhibit significantly higher levels of soil erosion in comparison to temperate areas (El-Swaify and Dangler 1982). The factors affecting elevated levels of soil erosion in the tropics include: (1) high annual precipitation (2) prolonged rainfall duration and high rainfall intensities, (3) high peak stream flows, (4) topography, (5) erodible geology and soils, (6) poorly drained soils, and (7) land use (Sessions 2007, Sheng 1982, Dunne and Dietrich 1982, Foster and others 1982, Akbarimehr and Naghdi 2012).

Rainfall intensities and peak stream flows in the tropics may be 10 times greater than observed in temperate regions (Sessions 2007). Tropical erosion studies have shown that subsurface flow and saturation overflow are the major runoff processes in tropical forested catchments (Dunne and Dietrich 1982). High rainfall intensities often exceed the infiltration capacity of poorly drained and erodible soils resulting in increased Hortonian overland flow and intense soil erosion (Ziegler and Giambelluca 1997, Dunne and Dietrich 1982, DeFranco and others 1993). In addition to natural environmental factors of climate, geology, and soils; soil erosion is exacerbated further by land use activities that strip protective vegetation, such as timber harvesting, road construction, cultivation, and rural development. Although some studies suggest that tropical soils are no less erodible than soils in other climatic regions, other studies indicate that erosion is a major problem if protective vegetation is removed (Douglas 1976, Sheng 1982).

The San Juan River basin of Costa Rica and Nicaragua experiences 2,500 mm to 6,000 mm of annual rainfall. Accelerated soil erosion originating from the upper and middle portions of the basin is a result of heavy rainfall, erodible volcanic soils, and land use activities including deforestation and agriculture (MINAE and MARENA 1997). The Juan Rafael Mora Porras Road (Route 1856) is built in areas underlain by erodible volcanic soils (Typic and Oxic Dystropepts and Aeric Tropaquept) derived from alkalic lava flows, pyroclastic rocks, and lahars; and young, poorly drained soils (Typic Hydraquent) derived from Quaternary alluvial deposits (Perez and others 1978).

Road-related erosion in the tropics

Unpaved roads surfaces are considered to be a large anthropogenic (human caused) contributor to excess Hortonian overland flow and consequent road surface erosion and sedimentation (Ziegler and Giambelluca 1997). For example, studies suggest that 90% of soil erosion resulting from timber harvesting activities in the tropics is caused by roads (Douglas 2003). Compacted road surfaces have very low infiltration capacity, and as a result interrupt normal drainage patterns and convey sediment-laden surface flow, which in turn causes rilling and gullying and delivery of fine sediments to hydrologically connected streams and waterways (Sidle and Ziegler 2012, Ziegler and Giambelluca 1997). In addition, tropical roads have the potential to discharge chemical and nutrient pollutants to local waterways, increase the invasion of exotic vegetation, and create barriers to sensitive wildlife (Goosem and others 2010, Laurence 2012).

In steep tropical areas, the largest source of road-related sediment is from large landslides and debris flows (Anderson and MacDonald 1998). According to Bruijnzeel (1993), hillslope gully erosion is a relatively rare source of erosion on undisturbed landscapes in the wet tropical and humid zones. However, gully erosion is apparent in areas that have been disturbed by overgrazing, burning, and poor agriculture activities; as well as from roads and road construction sites due to poor road surface drainage (Bruijnzeel 1993).

In tropical areas underlain by gentler topography or lowland settings, the primary sources of road-related erosion are from unstable cut and fill slopes, surface erosion from poorly drained road surfaces, and fluvial erosion from poorly designed stream crossings (Anderson and MacDonald 1998, Ziegler and Giambelluca 1997). Road surfaces have the potential to be chronic sources of erosion and sedimentation through the following processes: (1) vehicle traffic; (2) surface erosion by rainfall impact, rilling, and gullying of bare soils and road surfaces; (3) livestock usage, and (4) other biological activities (Ziegler and Giambelluca 1997). For further information on the environmental impacts of road construction, Spinelli and Marchi (1998) provide an extensive reference list of worldwide publications discussing road-related erosion and impacts to hydrogeology, soils, and water quality.

Best management practices in tropical areas

> *"Concern for the environment and for rising costs has increased the importance of engineering for all levels of forest roads. It is no longer feasible to "eye-ball" (the) design and (then) construct a forest road that may not meet the needs of the users or has a higher probability of failure with the resulting costs and environmental degradation."* (Aulerich 1996)

Depending on soil conditions, climatic factors, and usage, poorly designed roads can cause significant erosion that results in landscape degradation, poor water quality, socioeconomic impacts, and high costs for operation and maintenance. Road-related erosion can be minimized through careful road planning, design, construction, and maintenance (Mrema and others 2011). Specific road design and construction guidelines, and best management practices (BMPs) tailored to tropical environments, are necessary in order to develop a road system that is cost-effective to construct and maintain, and results in minimal environmental degradation.

In the last two decades, progress has been made to develop road construction guidelines and BMPs specifically tailored for the tropics. Prior to this time, road BMPs developed in temperate regions of the United States (e.g., Pacific Northwest) and Europe were used as the standard practice for tropical countries. The physics of erosion and mass wasting, and the general effects of climate and soils on post-construction geomorphic processes, have been researched for over 60 years and are fairly well understood. Much of this understanding has originated from research conducted in North America, and specifically in temperate, wet-temperate and subtropical areas of the western and southeastern United States. More recent research in the humid tropics has begun to elucidate additional elements that are unique to that climatic regime. All these studies are designed to more accurately represent the different environmental and socioeconomic conditions, and landscape heterogeneity of tropical regions (Harden 1990). For example, recent research has began to address the development of specific harvesting codes of practice, including road construction guidelines for tropical regions. Several tropical countries, with support from the Food and Agriculture Organization of the United Nations (FAO), developed harvesting codes of practice that include road construction guidelines and measures specific to each country or region's needs.

The earliest harvesting codes of practice (including guidelines for road construction) were developed in 1990 for the Republic of Fiji with the assistance of the International Labor Organization (ILO) and FAO. In 1996, the FAO "Model Code of Harvesting Practice" was developed by Dennis Dykstra, Center for International Forestry Research, Indonesia, in order to provide a general guidebook of techniques and practices for sustainable tropical forest management. This guidebook was used until 2006 by 30 tropical countries as the template for harvest planning and practices, and road construction (Sessions 2007). Further development of harvesting codes of practice, road engineering guidelines, and BMPs were developed for tropical regions in Asia and the Pacific, and West and Central Africa (FAO, 1999, FAO 2005). The FAO/ILO harvesting codes of practice were developed to promote harvesting practices that improve standards of utilization and reduce environmental impacts (Sessions 2007).

In addition to specific harvesting codes of practice, the FAO outlined general techniques for road construction, design, and planning in the "Watershed Management Field Manual: Watershed Survey and Planning" and the "Guide to Forest Road Engineering in Mountainous Terrain" published in 1990 and 2007, respectively (Sheng 1990, Fannin and Lorbach 2007). The "Guide to Forest Road Engineering in Mountainous Terrain" is intended as a companion to the FAO "Model Code of Harvesting Practice."

Between 2004 and 2006, the Tropical Forest Foundation (funded by the International Tropical Timber Organization (ITTO)), developed four technical procedures manuals intended to provide clear, technical guidance on the implementation of a Reduced Impact Logging management strategy in dipterocarp forests of Indonesia (Klassen 2006). The fourth manual specifically deals with the planning, location, design, construction, and maintenance of "low impact" forest roads tailored to tropical forest management.

Early examples of road BMP manuals for Latin America include "Caminos rurales con impactos minimos" (minimum impact rural roads) (Keller and others 1995) and "Practicas Mejoradas de Caminos Forestales" (Manual of Best Management Practices for Forest Roads) (Keller and Sherar 2000). Both were published in Spanish by the U.S. Agency for International Development (USAID) for use throughout Latin America and have proven valuable in helping to protect forest-based resources. For broader world-wide circulation the BMP road manual was then updated and published in English by USAID and the US Forest Service as "Low-Volume Roads Engineering - Best Management Practices Field Guide" (Keller and Sherar 2003). Similarly, in 2007, John Sessions, Department of Forest Engineering, Oregon State University, published a general guidebook for the planning, construction and maintenance of forest road systems in the tropics. This guidebook provides a comprehensive approach to road design and construction, BMPs, specifications for road drainage structures, required heavy equipment, and estimated road construction and maintenance costs based on the unique conditions of a tropical environment and its potential issues.

In general, the objective for forest road construction is low-cost design, construction and maintenance for the intended use, while maintaining safe operation and environmental protection (Sessions 2007). As with temperate locations, road system development in tropical areas requires a four-phase process including (1) planning, (2) design, (3) construction, and (4) operation and maintenance. Tropical road construction must incorporate cost-effective and proper design and engineering to mitigate the effects of prolonged wet periods and high rainfall intensities, high peak stream flows, poorly drained soils, and unstable geology, as well as the lack of good quality on-site fill materials and road rock (Sessions 2007).

The FAO harvesting codes of practice and guidelines for road construction, and other guidebooks and technical manuals discussed above, contain detailed design specifications for planning and best management practices for road construction in the tropics. The following section outlines general guidelines and basic best management practices to be implemented during construction in tropical areas. These practices compliment those BMP measures already outlined for forest roads built in more temperate and subtropical settings.

Road location

A well planned road location can be one of the most important factors when constructing a road. If improperly located, a road may increase erosion and fine sediment delivery to streams and waterbodies. Field reconnaissance of the potential route for road construction should be conducted prior to road design and construction in order to identify the best location for a proposed road and to identify potentially unstable hillslopes, problematic site features and obstacles, and unfavorable site locations.

- Roads should be widely spaced on the landscape. The best locations for roads are on ridgetops, along the margins of stream valleys, or on stable bench locations and low gradient hillslopes where effective road drainage can be easily developed.
- The two riskiest locations for roads are directly adjacent to streams and rivers, and on steep, potentially unstable slopes adjacent to watercourses. In locations that experience high rainfall intensities and peak stream flows, streamside roads can become flooded and eroded. Roads built on steep slopes are subject to mass wasting and failure of road-stream crossings when culverts become plugged and streamflow diverts across the road or down adjacent hillslopes. Although, stream valleys can be a good location for forest roads, they should be constructed outside the riparian zone and floodplain, and above flood flow elevations (Adams and Andrus 1990).
- Roads should be constructed on stable hillslopes. Locations on steep and concave hillslopes with poor soils or unstable geology should be avoided. In areas that experience high rainfall intensities, concave slopes between 50% and 70% slope gradient may be at a higher risk of mass failure (Adams and Andrus 1990).
- Roads should be constructed parallel to the slope contour and not perpendicular to slope.
- If roads are built adjacent to streams, a vegetation buffer strip should be retained to filter eroded sediment and minimize bank erosion.
- Avoid steep and unstable areas, including: gullies, wet terrain, swamps and mangroves, wetlands/watercourses, conservation/reserve areas, and areas with large rock hillslopes that may be prone to rock falls or rock topples (FAO 1999, Klassen 2006).
- Roads should be located to reduce the frequency of stream crossings. Road approaches to stream crossings should be constructed at right angles to the stream channel to avoid stream channel and fill erosion.

Road Design

A properly designed road is extremely important in order to control road-related erosion and sediment delivery to streams. Table 1 illustrates the typical design characteristics of tropical forest roads developed by Heinrich (1975).

- Road width is an important road design element that may have significant effects on road-related erosion. Although road width and road length (together with hillslope steepness) control the amount of ground disturbed by road construction, road width can extend well beyond the road tread surface and is directly related to the nature and steepness of the cutbank and fillslope (Adams and Andrus 1990). Where feasible, minimize road widths as much as possible without affecting road integrity or road functionality.

Table 1. Characteristics for forest roads in the tropics (modified from Sessions (2007) and Heinrich (1975))

Road type	Road use	Road width (including shoulders) (m)	Width of travel way (m)[a]	Minimum curve radius (m)	Maximum gradient (%)	Truck loads per day (#)	Traffic speed (km/h)	Cost estimate (relative cost units per meter of road)
Access	Truck	9-12	7-10	50	6 (8)[b]	More than 50	50-60	10-15
Main	Truck	8-10	6-8	30	8 (10)[b]	Up to 50	25-40	7-10
Secondary	Truck	6-8	5-6	20	10 (12)[c]	Up to 6	15-25	1-7

[a] In steep and difficult terrain conditions the road widths given have to be reduced considerably.
[b] Maximum gradient in steep, difficult terrain for unloaded trucks when driving uphill.
[c] Maximum gradient in steep, difficult terrain for a short distance.

- Slope embankments should not exceed 1:1 on well-drained soils and stable geology. For wet soils, slope embankments should not exceed 1:3 (Mrema and others 2011). If possible avoid cut and fill construction in unstable areas.
- Attempt "full bench" construction wherever possible in order to reduce the likelihood of mass failure of fillslopes and elevated surface erosion rates (Adams and Andrus 1990).
- Wood and organic materials should be removed from fill materials used in road construction. Wet and clayey soils should be avoided as fill materials.
- Evaluate peak flows in order to correctly size stream crossing culverts or design other stream crossing structures (e.g., bridges). Stream crossings must be designed to withstand high peak flows without erosion. In the humid tropics, peak flows of a 10- or 25-yr return interval storm can be 10 times greater than in temperate watersheds of similar size. Therefore, culverts may only be suitable for watersheds of a relatively small size (Adams and Andrus 1990). It is best to be conservative and size road-stream crossing drainage structures for the 100-yr design peak flow.
- Install culverts with wing walls and controlled overflow structures (e.g., emergency spillways or rocked outboard fillslopes) in case of extreme flow events (Mrema and others, 2011).
- Minimize the number of drainage crossings and eliminate stream "diversion potential" at all stream crossings.

- Install well-designed low water fords and bridges at locations where high water is expected (Adams and Andrus 1990).
- Drain the road surface using road shaping treatments intended to effectively shed and disperse runoff from the road surface, thereby reducing concentrated surface runoff (e.g., road outsloping).
- Minimize the use of ditch relief culverts. In the humid tropics where high peak flows are common, the drainage capacity of ditch relief culverts is easily exceeded. Instead use a combination of road shaping techniques and frequently spaced rolling dips.
- Road surface erosion can be reduced by applying rock surfacing. Use good quality, clean rock or gravel applied in thicknesses dictated by traffic volume and road grade. Although road rock may be expensive or difficult to procure in rural tropical areas, the cost investment may be offset by easier road access and utilization, and lower maintenance costs compared to an unsurfaced road.

<u>Road construction</u>
Constructing roads in the tropics where annual precipitation is extremely high can be very challenging. Care should be taken in the timing and sequencing of road construction activities by developing schedules and timetables for proposed road building activities.

- Prior to construction activities, the engineered road route should be staked for the equipment operators. All locations of seepage, soft boggy areas, and streams should be clearly marked and included in the construction log and technical drawings.
- Road construction should occur at the onset of the dry weather season. Avoid equipment operations during wet periods or directly after periods when soils are wet or saturated.
- Drainage structures should be constructed as soon as possible during the construction of the road subgrade. The road subgrade should be properly constructed to effectively control seepage and shed any runoff that occurs during the construction period (Klassen 2006).
- Compact the road subgrade immediately after or concurrent with construction in order to minimize surface erosion during potential rainfall events.
- Apply surface erosion control measures, such as planting and seeding/mulching with well adapted plant species, or organic slash packing, on bare soil areas concurrent with or immediately after construction activities to reduce surface erosion. These erosion control measures should be implemented on open construction areas prior to forecast rainfall events and over the entire construction sites prior to the wet weather season.
- Culvert pipes should be placed at a minimum of 600mm below the high point of the road (FAO 1999).
- Stream crossing culvert gradients should be installed at 1-3% in order to reduce siltation in the pipe or excessive scouring at the culvert outlet (FAO 1999). In mountainous terrain, culverts should be set into the bottom of the channel at the natural channel grade and orientation. Rock armor may be needed at the culvert outlet to prevent erosion.

Road maintenance

Proper road maintenance is a key component to the cost, functionality, and integrity of a road, as well as providing essential protective measures for soil stability and water quality.

- Roads should be inspected regularly to ensure that drainage structures are working effectively and to identify locations of existing or potential sources of road erosion. This is extremely important during wet weather periods and following storm and flood events.
- Ditches and culverts should be inspected and maintained free of debris.
- Road shape should be maintained as designed during road grading activities. Care should be taken not to build berms along the outboard edge of the road alignment during road re-grading and maintenance activities. Efforts should be taken to ensure that road surface runoff is well dispersed and not collected and concentrated on the road surface or in ditches so as to cause rilling and gullying.

Road planning, design, construction and maintenance standards developed for tropical regions include the same basic elements developed over the last 60 years for temperate and semi-tropical climates. Tropical best management practices are modified to include basic design and construction techniques that are focused and relevant to the climates and soils characteristic of tropical environments. These include BMPs that account for differences in rainfall intensity and duration, as well as soil characteristics common to perennially wet volcanic terrains such as those in the Rio San Juan River basin and elsewhere. Basic geomorphic processes that are affected by road construction in the tropical environment, including mass wasting, gullying, stream crossing failures, and surface erosion, are controlled by the same physical principals of erosion and sedimentation. Tropical climatic, geologic, and pedologic conditions simply add a few additional factors into the equation of how to plan and build forest road systems that meet the needs of the users while providing environmental protection to on-site and downstream off-site resources.

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APPENDIX D: Grain Size of Sediment Samples

Humboldt State University Geology Soils Lab, Arcata, California

Río San Juan de Nicaragua sediment sample analysis for Pacific Watershed Associates
December 2, 2012

Table 1: Results of particle size analysis of soil samples with soil texture and corresponding colors to soil texture triangle, Figure 1.

Sample	Location (km) see map	Total Sample Weight (g)	Total Sand Weight (g)	Total Sand %	Total Silt Weight (g)	Total Silt %	Total Clay Weight (g)	Total Clay %	Soil Texture Family Class
2-1	0.75	Three (3) 6 to 10 cm pebble clasts							
2-10	6.25	25.5	9.8	40.3	7.9	32.4	6.6	27.3	Loam (red)
2-11	6.50	24.5	11.4	49.2	6.5	28.1	5.3	22.7	Loam (blue)
2-12	6.80	23.7	13.9	84.2	1.5	9.0	1.1	6.8	Loamy Sand (green)
2-18	8.50	24.9	3.4	14.1	14.6	61.2	5.9	24.7	Silt Loam (yellow)
2-27	17.95	22.9	10.9	62.4	4.0	22.9	2.6	14.7	Sandy Loam (orange)

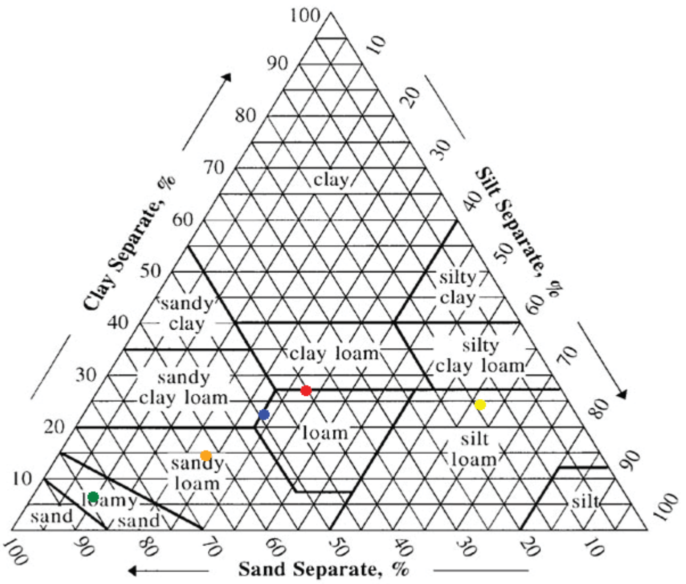


Figure 1: A textural triangle displaying Samples #2-10 (red), #2-11(blue), #2-12 (green), #2-18 (yellow), and #2-27 (Orange).

Table 2: Results of rock fragments analysis greater than 2 mm.

Sample	Weight of sample (g)	Total weight gravel of > 2 mm (g)	Total % of gravels > 2 mm
2-1	Three (3) 6 to 10 cm pebble clasts		
2-11	126.5	65.4	51.7
2-27	357.9	86.5	24.3

Samples #2-10, #2-12, and #2-18 had no gravels > 2 mm. Upon drying, what appeared to be large pebbles were determined to be well indurated aggregations of sand, silt, and clay that had been rounded by fluvial transport processes.

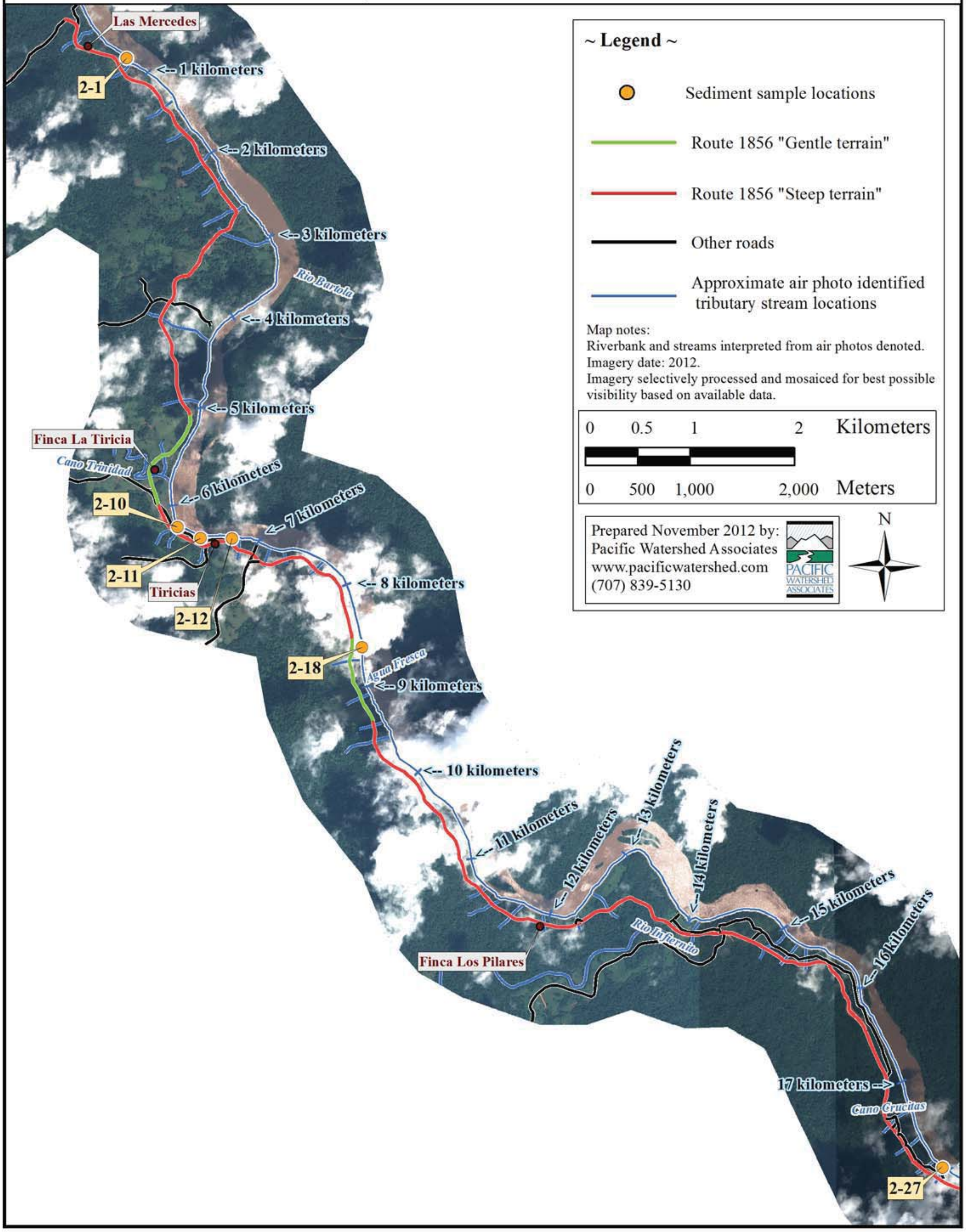
Standard Laboratory Procedures for Humboldt State University Soils Laboratory

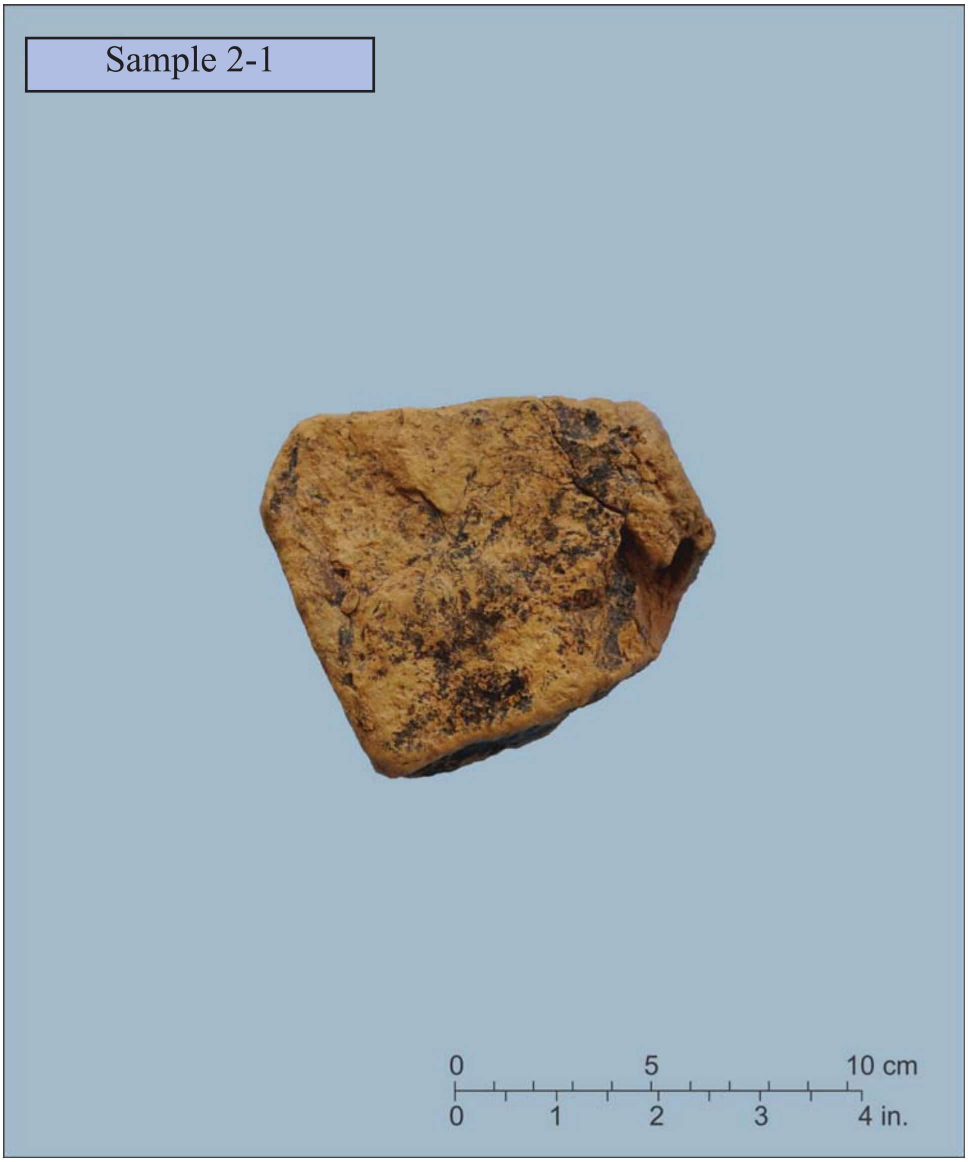
Samples were assigned a Humboldt State University Laboratory number, air dried, hand sieved to separate gravels from sands, silts, and clays, then divided for various tests using a splitter to ensure representative proportions for each component.

Organic Matter Content
A 3-5 g split was heated to 105^{0}C and compared to the air dry weight to determine water content, reported here as moisture factor. The sample was then heated to 450^{0}C and compared to the 105^{0} C weight to determine loss on ignition (loi), reported in %, a proxy for organic matter (OM) content, reported in grams (Singer and Janitsky, 1986).

Particle Size Distribution
All samples were treated with 0.5N hydrochloric acid (HCl) to dissolve calcium carbonate, which inhibits deflocculation, then rinsed with distilled water. Samples were then treated with ~30% hydrogen peroxide to burn off organic matter. Twenty-five ml of sodium hexametaphosphate was then added to the sample and was allowed to react for a minimum of 24 hours. Twenty minutes of ultrasonic treatment was also used to encourage deflocculation. Samples were wet sieved with distilled water to recover the sand portion of the sample. The remaining portion of the sample was then brought up to a total volume of 1 liter of solution using additional distilled water as needed, then analyzed by pipette to determine the silt and clay proportions of the sample as per Singer and Janitsky (1986).

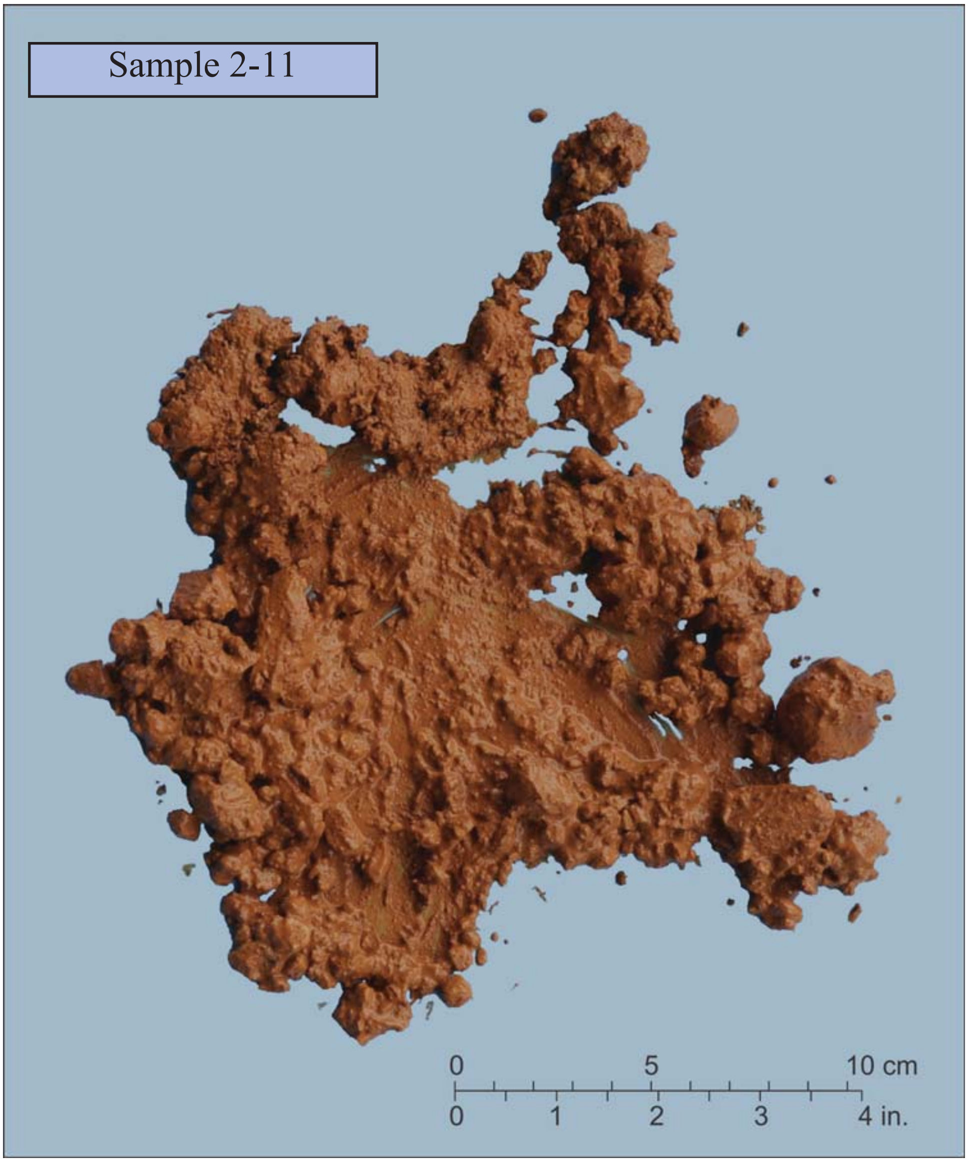
Appendix D. Location of sediment sample at several of the Rio San Juan observed terraced outwash deposits downslope from Route 1856 above the Rio San Carlos confluence, Costa Rica.

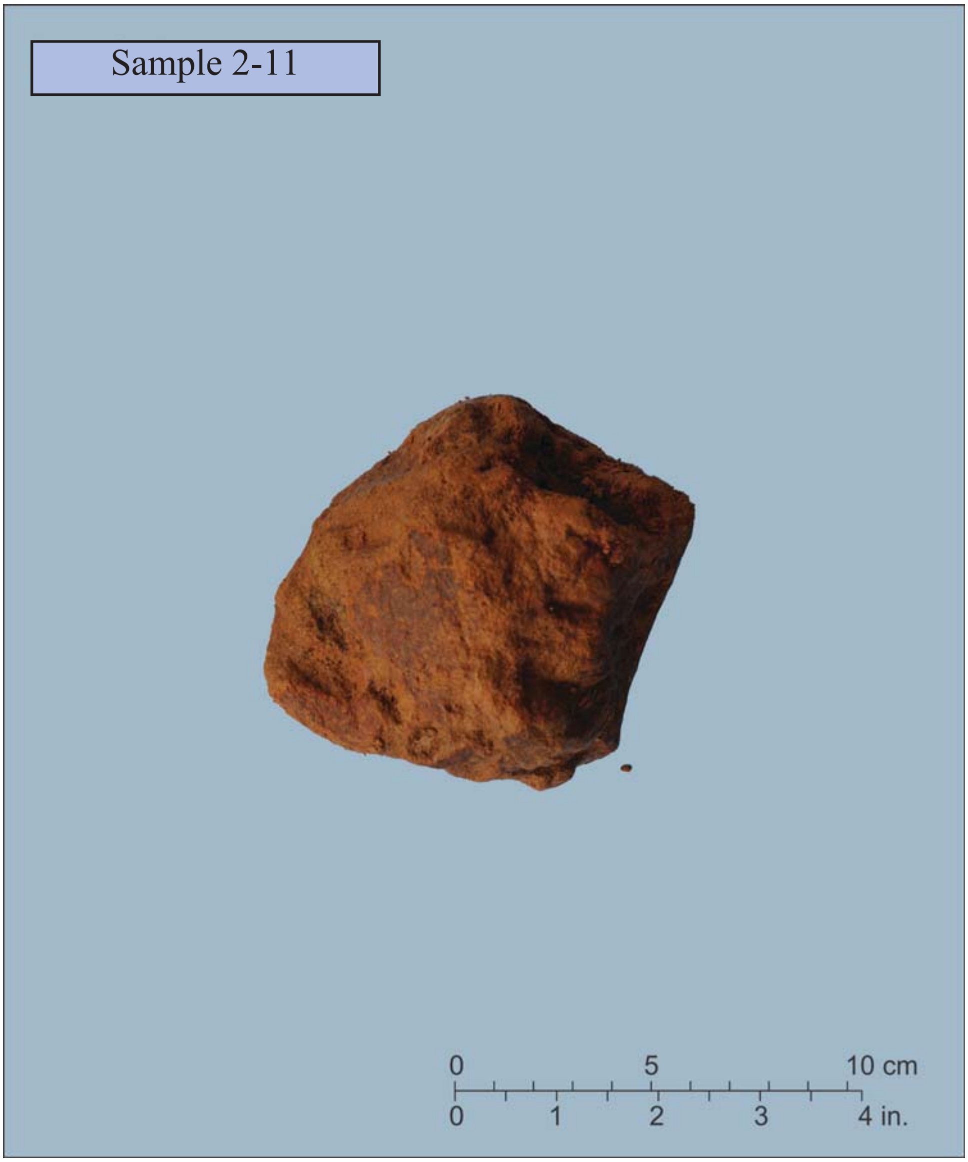



Sample 2-1
0
5
10 cm
0
1
2
3
4 in.

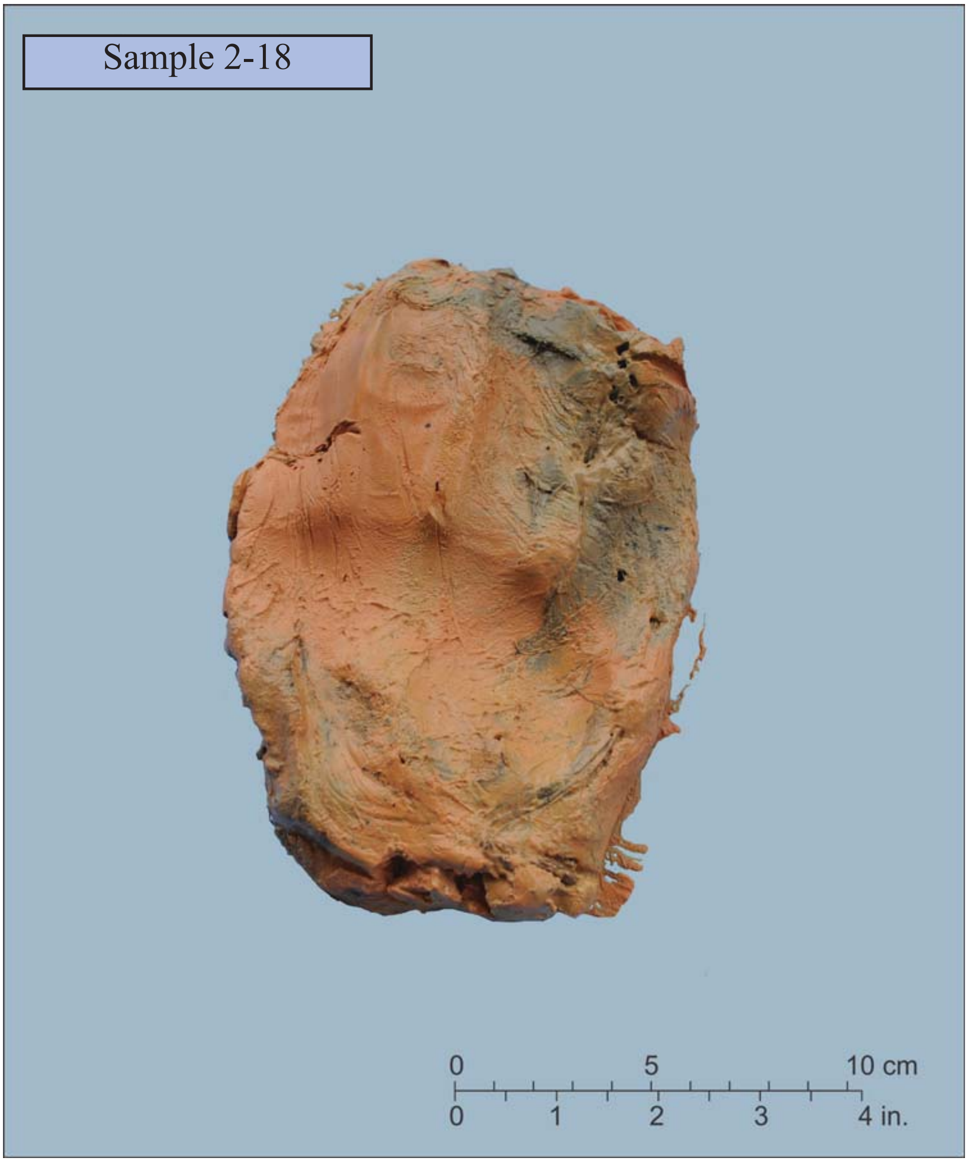

Sample 2-1
0
5
10 cm
0
1
2
3
4 in.


Sample 2-10
0
5
10 cm
0
1
2
3
4 in.


Sample 2-11
0
5
10 cm
0
1
2
3
4 in.


Sample 2-11
0
5
10 cm
0
1
2
3
4 in.

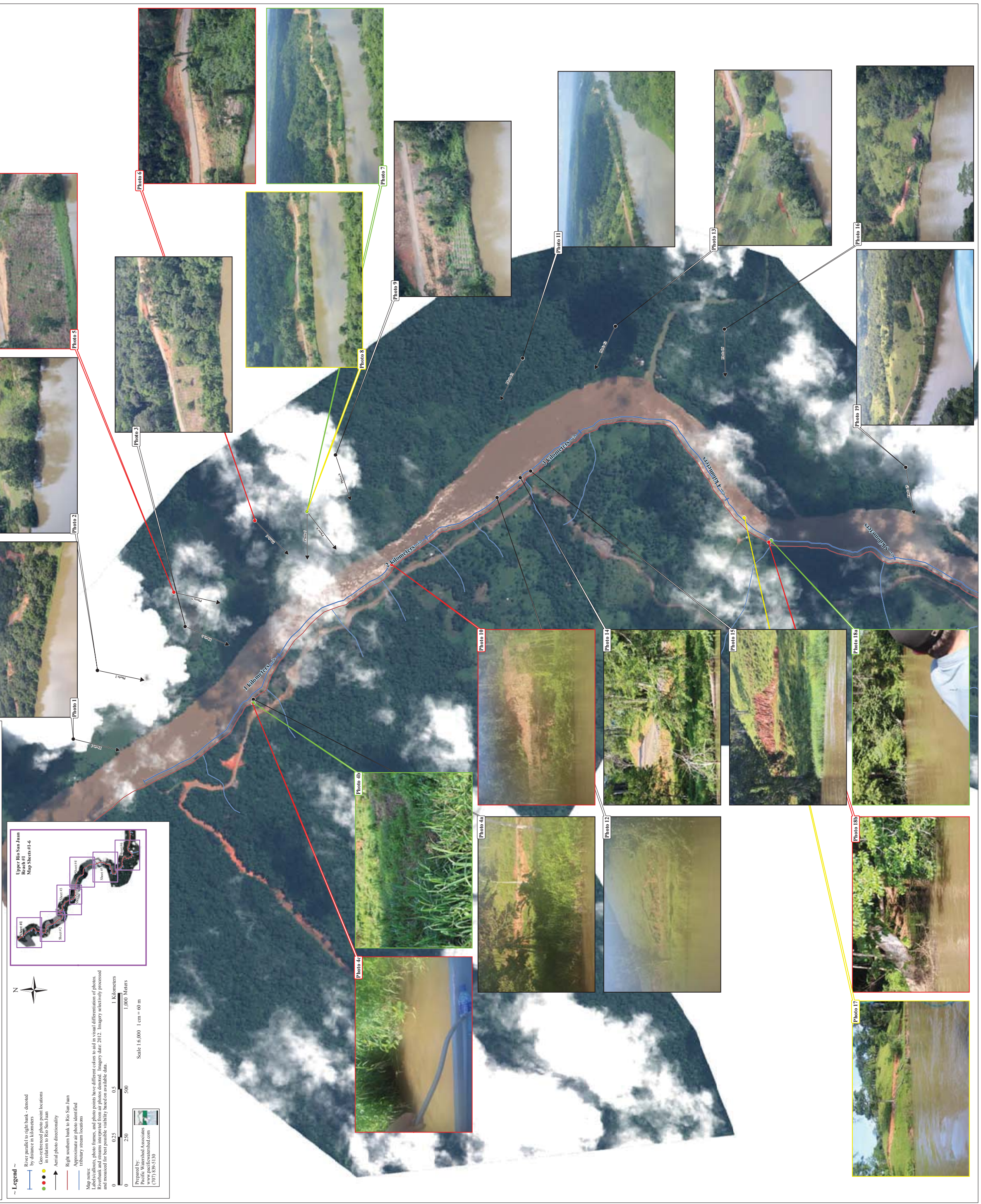

Sample 2-12
0
5
10 cm
0
1
2
3
4 in.

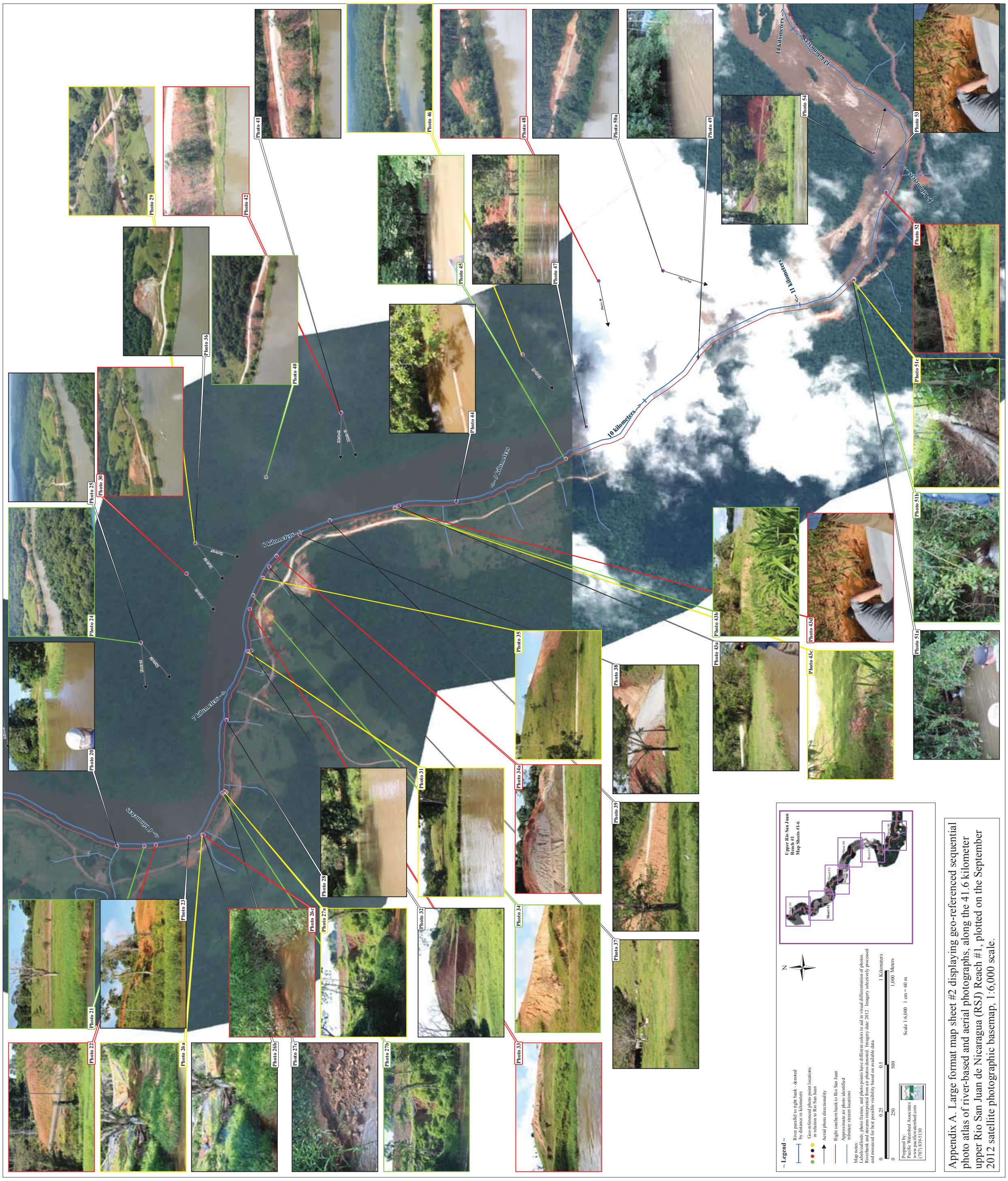

Sample 2-18
0 5 10 cm
0 1 2 3 4 in.


Sample 2-27
0
5
10 cm
0
1
2
3
4 in.

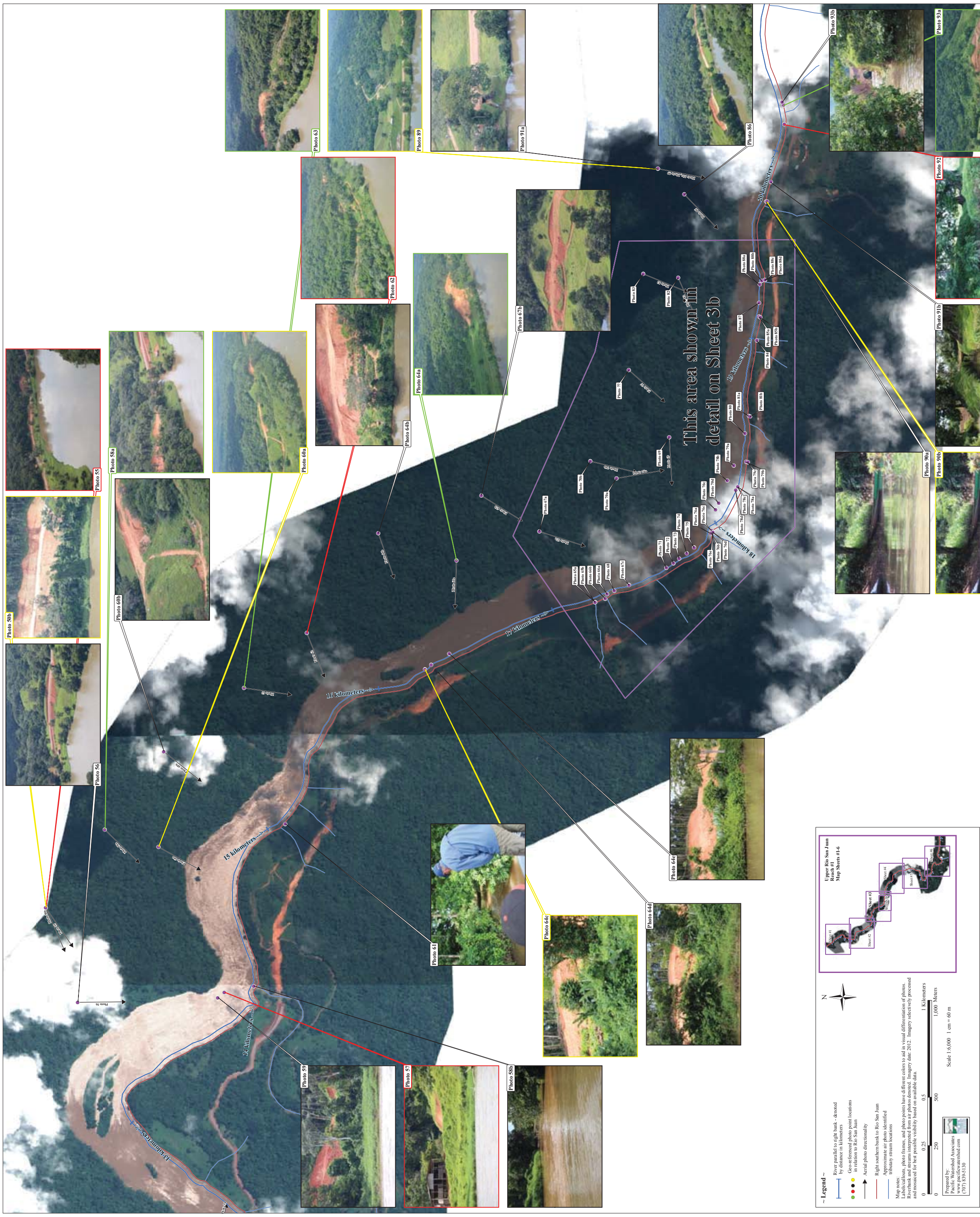
APPENDIX E: Large-Format Maps of Route 1856 and Río San Juan Upstream from Río San Carlos

Appendix A. Large format map sheet #1 displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.

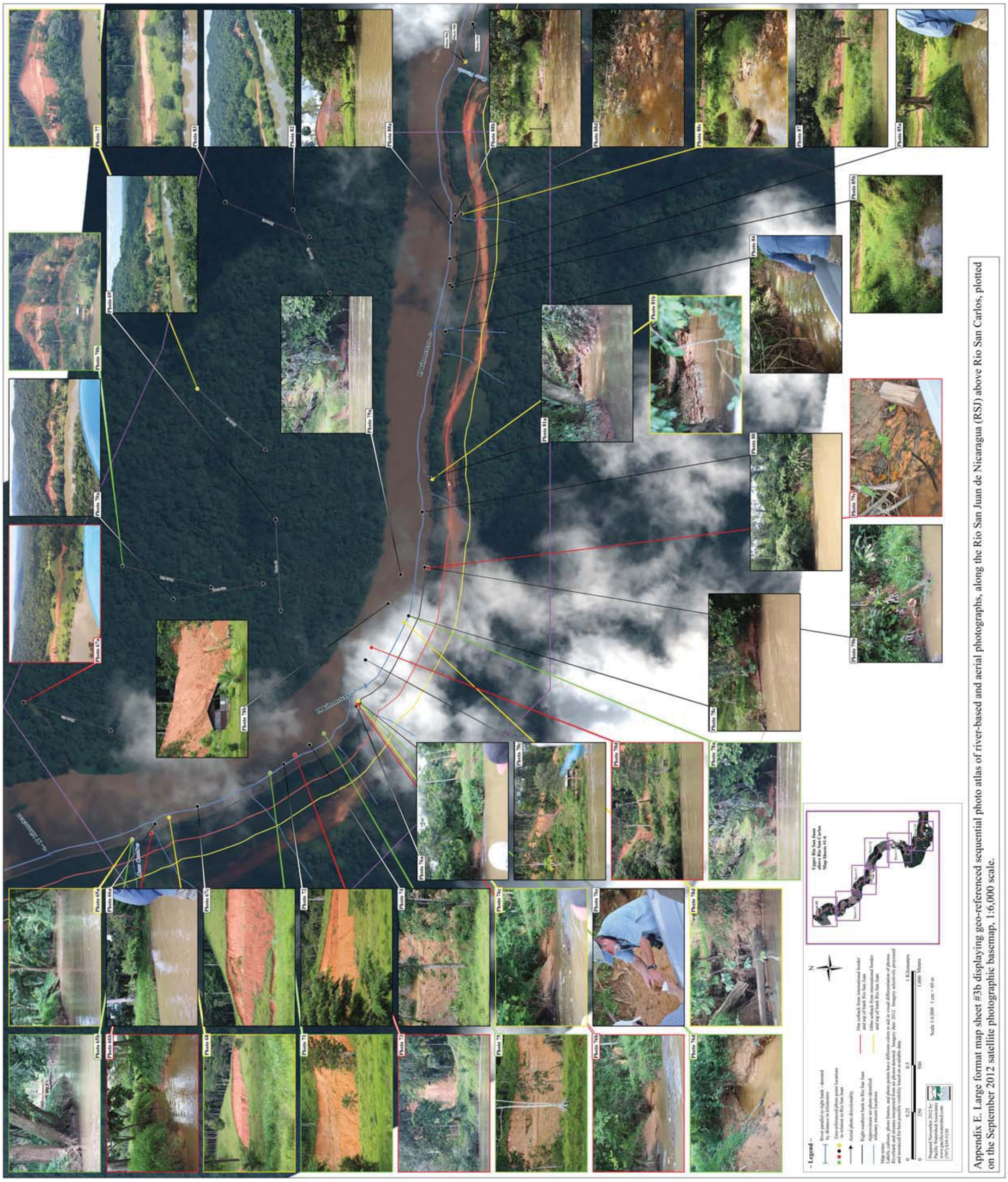




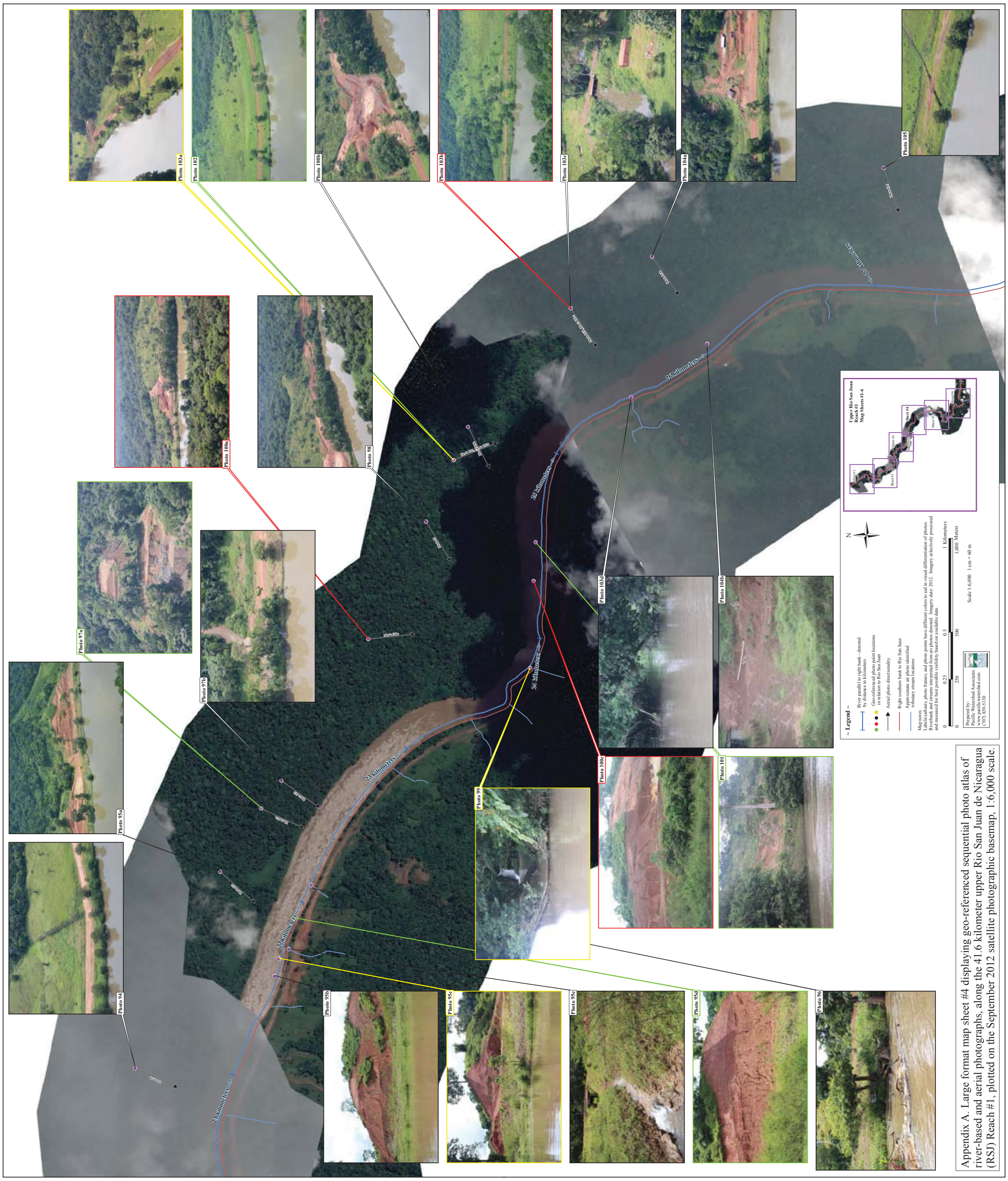
Appendix A. Large format map sheet #2 displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.



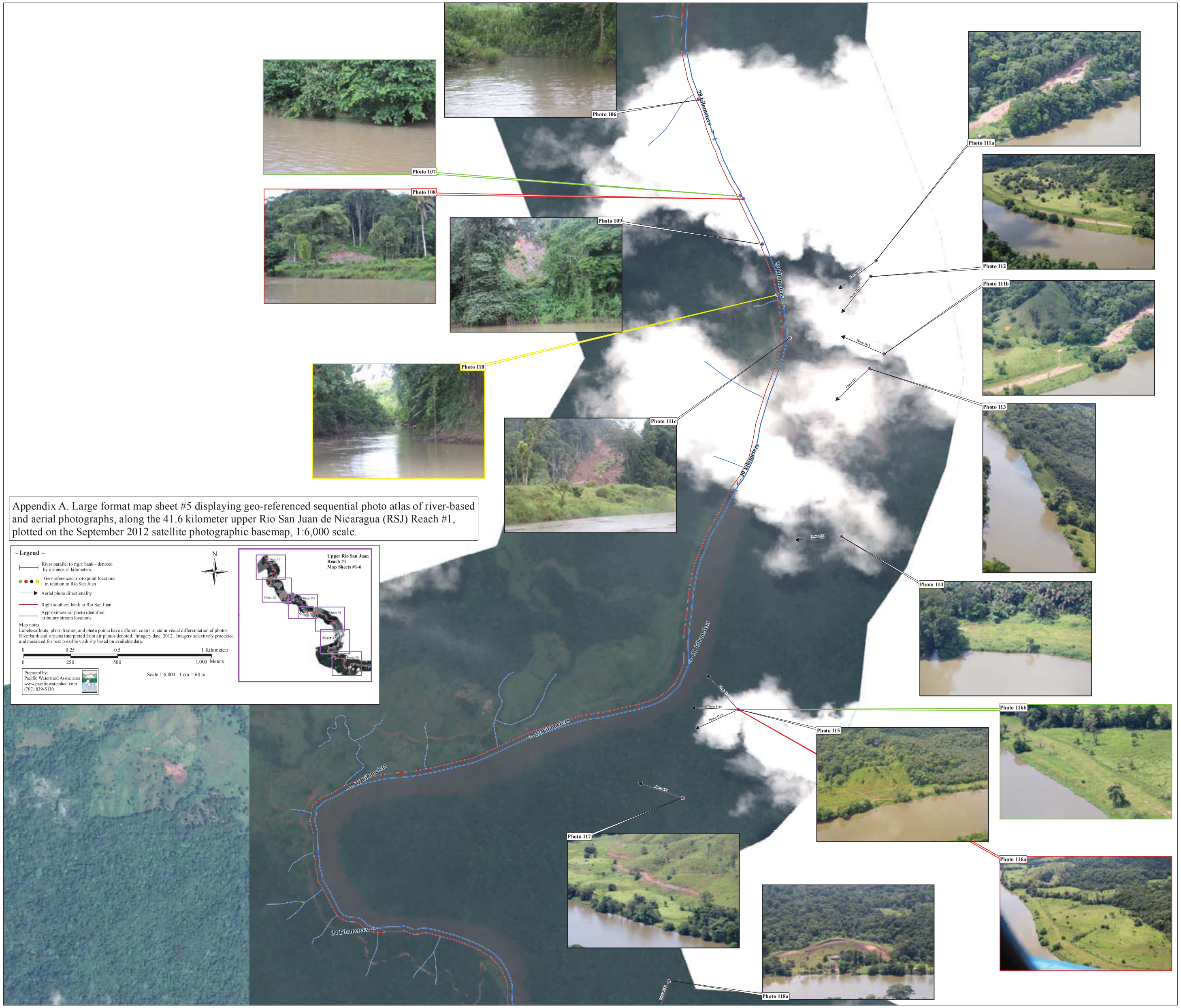
Appendix A. Large format map sheet #3a displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.



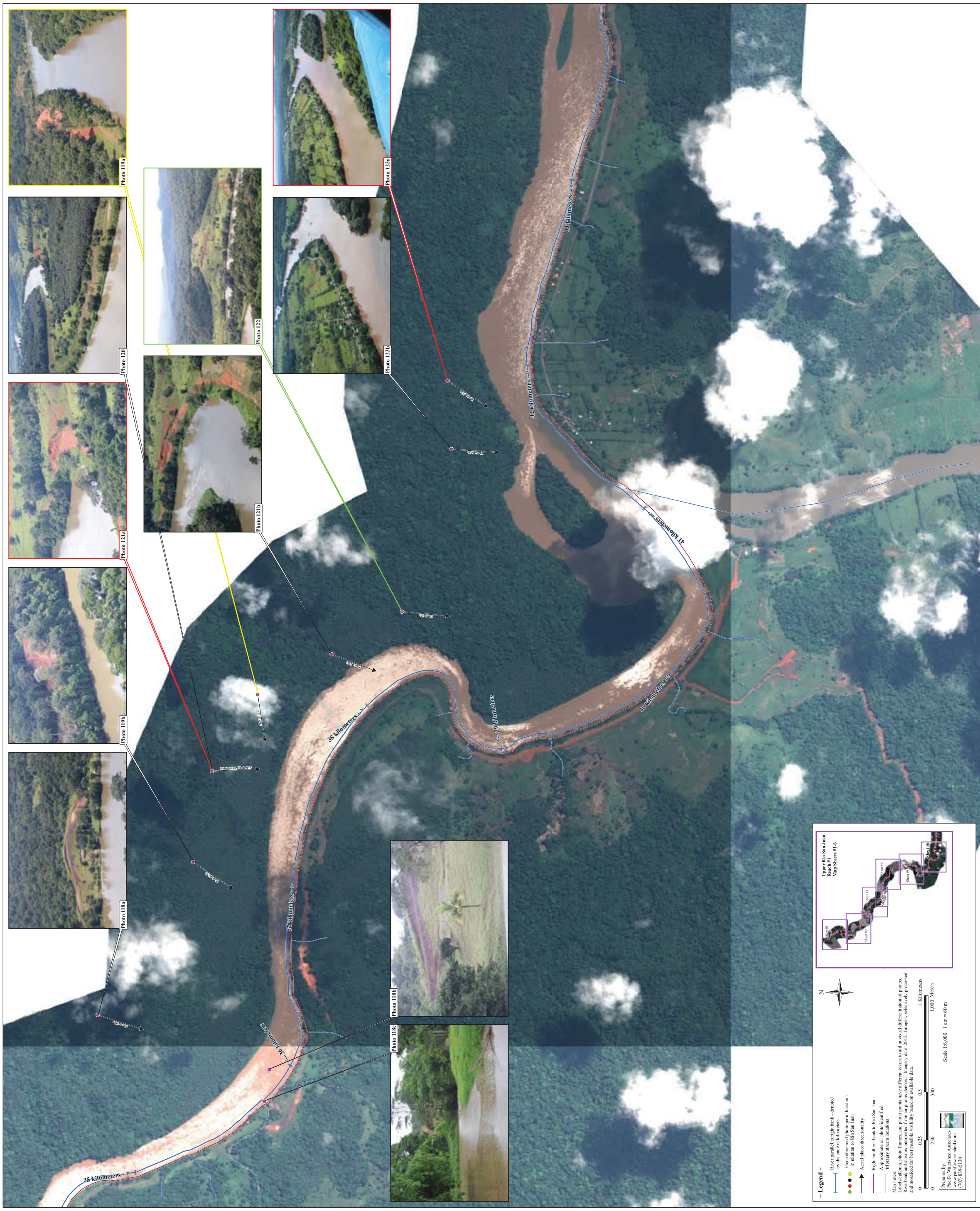
Appendix E. Large format map sheet #3b displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the Rio San Juan de Nicaragua (RSJ) above Rio San Carlos, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.



Appendix A. Large format map sheet #4 displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.



Appendix A. Large format map sheet #5 displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap, 1:6,000 scale.



Appendix A. Large format map sheet #6 displaying geo-referenced sequential photo atlas of river-based and aerial photographs, along the 41.6 kilometer upper Rio San Juan de Nicaragua (RSJ) Reach #1, plotted on the September 2012 satellite photographic basemap. 1:6,000 scale.

APPENDIX F: Author CVs

Curriculum Vitae *CV2012-8pp.doc*

G. MATHIAS KONDOLF
Professor of Environmental Planning and Geography
Chair, Dept Landscape Architecture and Environmental Planning
202 Wurster Hall, University of California, Berkeley CA 94720 USA
kondolf@berkeley.edu

EDUCATION

The Johns Hopkins University. PhD, Geography and Environmental Engineering 1988. Dissertation: *Salmonid spawning gravels: A geomorphic perspective on their distribution, size modification by spawning fish, and application of criteria for gravel quality.*
University of California at Santa Cruz. MS, Earth Sciences 1982. Thesis: *Recent channel instability and historic channel changes of the Carmel River, Monterey County, California.*
Princeton University. AB cum laude, Geology 1978. Thesis: *Genesis and development of Sandy Hook, New Jersey*

PROFESSIONAL EXPERIENCE

University of California at Berkeley
Chair, Department of Landscape Architecture and Environmental Planning: 2011-present
Professor of Environmental Planning and Geography: 2007 to present (appointed Asst Prof 1988)
Chair, Portuguese Studies Program: 2001-present
Regular university courses:
Mediterranean-Climate Landscapes, Environmental Sciences for Sustainable Development, River Restoration, Hydrology for Planners.
Professional shortcourses:
Week-long shortcourse *Geomorphic and ecological fundamentals for river and stream restoration* offered annually since 1995 at Sagehen Creek Field Station, Truckee, California, and components taught also at Beaumont du Ventoux and Lyon, France, University of Lisbon, and National Cheng Kung University, Taiwan.

SERVICE ON EDITORIAL BOARDS

Associate Editor, Water Resources Research (2011 to present)
Associate Editor, Environmental Management (1999 to present)

SERVICE ON GOVERNMENT ADVISORY BOARDS

Technical Review Committee for the Greater Mississippi Basin Post-Flood Assessment, US Army Corps of Engineers: 2012-2013
National Research Council Committee on Hydrology, Ecology, Fishes of the Klamath River Basin Member: 2006-2007
Federal Interagency Flood Risk Management Committee Member: 2005-2007
Environmental Advisory Board to the Chief of the US Army Corps of Engineers: Member: 2002-2007
CALFED Bay-Delta Program Ecosystem Restoration Program Science Board: Member: 1999-2005

RECENT PEER-REVIEWED PUBLICATIONS

Kondolf, G.M., K. Podolak, and T.E. Grantham. 2012. Restoring Mediterranean-climate rivers. *Hydrobiologia*. DOI 10.1007/s10750-012-1363-y

Deitch, M.J., and G. M. Kondolf. 2012. Consequences of variations in magnitude and duration of an instream environmental flow threshold across a longitudinal gradient. *Journal of Hydrology* 420–421: 17–24. DOI:10.1016/j.jhydrol.2011.11.003

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Kilber, K. D. Tullos, and G.M. Kondolf. 2011. Learning from dam removal monitoring: challenges to selecting experimental design and establishing significance of outcomes. *River Research and Applications* 27:967-975. DOI: 10.1002/rra.1415

MacWilliams, M.L., M.R. Tompkins, R.L. Street, G.M. Kondolf, and P.K. Kitanidis. 2010. An assessment of the effectiveness of a constructed compound channel river restoration project on an incised stream. *Journal of Hydraulic Engineering* 136(12): 1042-1052. DOI: 10.1061/(ASCE)HY.1943-7900.0000196

Minear, T. and G.M. Kondolf. 2009. Estimating reservoir sedimentation rates at large spatial- and temporal-scales: a case study of California. *Water Resources Research* 45. W12502 doi:10.1029/2007WR006703

Bosselmann, P.C., G.M. Kondolf, J. Feng, G. Bao, Z. Zhang, and M. Liu. 2009. The future of a Chinese water village: alternative design practices aimed to provide new life for traditional water villages in the Pearl River Delta. *Journal of Urban Design* 15(2):243-267.

Constantine, J.A., T. Dunne, H. Piégay, and G.M. Kondolf. 2010. Controls on the alluviation of oxbow lakes by bed-material load as observed along the Sacramento River of California. *Sedimentology* 57:389-407.

Chin, A., S. Anderson, A. Collison, B. Ellis-Sugai, J.P. Haltiner, J. Hogervorst, G.M. Kondolf, L.S. O'Hirok, A.H. Purcell, and E. Wohl. 2009 Linking theory and practice for restoration of step-pool streams. *Environmental Management* 43:645-661.

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Kondolf, G.M., P. Angermeier, K. Cummins, T. Dunne, M. Healey, W. Kimmerer, P.B. Moyle, D. Murphy, D. Patten, S. Railsback, D. Reed, R. Spies, and R. Twiss. 2008. Prioritizing river restoration: Projecting cumulative benefits of multiple projects: an example from the Sacramento-San Joaquin River system in California. *Environmental Management* 42:933-945 (DOI: 10.1007/s00267-008-9162-y)

Rovira, A., and G.M. Kondolf. 2008. Bed mobility on the Deschutes River, Oregon: tracer gravel results. *Geodinamica Acta* 21:11-22.

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Kondolf, G.M., H. Piégay, and N. Landon. 2007. Changes since 1830 in the riparian zone of the lower Eygues River, France. *Landscape Ecology* 22:367-384.

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BOOKS

Kondolf, G.M., and H. Piégay, eds. 2003. *Tools in fluvial geomorphology*. John Wiley & Sons, Chichester, 696 pp.
(*Reviewed in Annals of the Association of American Geographers 95(3):713-715, 2005.)*

RECENT PAPERS PUBLISHED IN SYMPOSIA PROCEEDINGS AND BOOK CHAPTERS

Kondolf, GM, and Podolak K. 2011. Urban rivers: Landscapes of leisure and consumption. In PM Santos and PC Seixas, eds. *Globalization and Metropolization – theory and practice from Europe's west coast.* Institute of Governmental Studies, Berkeley (in press)

Kondolf, G.M. The espace de liberté and restoration of fluvial process: When can the river restore itself and when must we intervene? *River Conservation and Restoration*, P. Boon & Paul Raven, editors. John Wiley & Sons, Chichester. (in press)

Bouleau, G. and G.M. Kondolf. 2011. Rivers of diversity: evolving water regulation in California and the European Union. in *Transatlantic Regulatory Cooperation: The Shifting Roles of the EU, the US and California.* D. Vogel and J. Swinnen, eds. Edward Elgar, Cheltenham, UK. pp. 83-101.

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Kondolf, G.M. 2009. An environmental perspective in city-river relationships. *in Cities and rivers, perspectives towards a sustainable partnership*, Livro nº 8 da Colecção Expoentes, edições da PARQUE EXPO, através do Núcleo de Comunicação da Parque EXPO, Lisbon.

Kondolf, M. 2009. Rivers, meanders, and memory. pp. 106-119 in M. Treib, ed., *Spatial Recall,* Taylor & Francis (Routledge)

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Kondolf, G.M., and C-N. Yang. 2008. Planning river restoration projects: Social and cultural dimensions. pp.43-60 in D. Sear and S. Darby (eds.) *River Restoration: Managing the Uncertainty in Restoring Physical Habitat.* Wiley, Chichester.

Kondolf, G.M. 2006. When dams get old: Dam removal in western North America pp. 373-376 in Lanz, K., Mueller, L., Rentsch, C., and Schwarzenbach, R. P. eds.: *Who owns the water*? (*Wem gehoert das Wasser*?), Baden, Switzerland, Lars Müller Publishers. 536 pages.

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Kondolf, G.M. 2006. Floodplains and riparian corridors. In American Planning Association *Planning and urban design standards* (pp. 118-121). John Wiley & Sons, Hoboken, N.J.

Kondolf, G.M. 2006. Rivers and streams. In American Planning Association *Planning and urban design standards* (pp. 115-117). John Wiley & Sons, Hoboken, N.J.

RECENT TECHNICAL REPORTS

Serra-Llobet, A., G.M. Kondolf, and S. Nicholson. 2012. *Wise Use of Floodplains: Adaptation in America and Europe*. Proceedings from March 2012 workshop (in preparation)

Simons, C.W., and G.M. Kondolf, editors. 2012. Crossings: Natural and Cultural Values for Sustainable Development of the Naturtejo Geopark. *Institute of Urban and Regional Development Working Paper* No. 2012-01. University of California, Berkeley. Available online at: http://www.iurd.berkeley.edu/publications/wp/wp-2012-01.pdf

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Stein, ED, K Vyverberg, G M Kondolf, and K Janes. 2011. Episodic stream channels: imperatives for assessment and environmental planning in California. Proceedings of a special technical workshop, November 2010, Costa Mesa, California. *Southern California Coastal Water Research Project Report* No. 0645.

Kondolf, G.M., K. Podolak, and A. Gaffney (editors). 2010. From High Rise to Coast: Revitalizing Ribeira da Barcarena. Water Resources Center Report No.210, and Report WP 2010-01, Institute of Urban and Regional Development, and Institute of European Studies Publication 1102, University of California, Berkeley. Available online at http://iurd.berkeley.edu/catalog/Working_Paper_Titles/High_Rise_Coast_Revitalizing_Ribeira_da_Barcarena and at http://escholarship.org/uc/item/3q77s4ss#page-2

Kondolf, G.M., P. Carling, F. Fruchart, & C. Alford. 2010. Potential Post-Dam Changes in Sediment Supply and Channel Form in the Lower Mekong River: A Preliminary Assessment. Prepared for the Mekong River Commission Secretariat, Vientiane, February 2010

Mekong River Commission. 2009. *Design guidelines for Mekong Mainstem Dams*. (contributed approximately half of this document, specifying approaches for managing sediment in reservoirs) March 2009.

Kondolf, G.M. 2009. Restoration prospects for the Apalachicola River. Report to American Rivers, Washington, DC.

Kondolf, G.M. 2009. Guidelines for sand and gravel mining in Korean Rivers. Report submitted to K-Water (Korean Water Agency), May 2009.

Natali, J., G.M. Kondolf, C. Landeiro, J. Christian-Smith, S. Scheuer, and T. Grantham. 2009. A Living Mediterranean River: Restoration and Management of the Rio Real in Portugal to Achieve Good Ecological Condition. Available online at *http://repositories.cdlib.org/wrc/contributions/209*

Skabelund, L., G.M. Kondolf, C. Johnson, and A. Bukojemsky. 2009. Successful ecological restoration: A framework for planning/design professionals. American Association of Landscape Architects, Washington DC.

H. T. Harvey & Associates, G. M. Kondolf, Geomorph, Blankinship & Associates. 2008. Final Colusa Basin Watershed Assessment. Prepared for the Colusa County Resource Conservation District.

Kondolf, G.M., Tompkins, M.R, and McBain & Trush, Inc. 2008. Lower Deer Creek Ecosystem Restoration and Flood Management: Feasibility Study and Conceptual Design Project: Geomorphic and Biological Monitoring Report. Report to Deer Creek Watershed Conservancy, Vina, California.

Grantham, T., J. Christian-Smith, G.M. Kondolf, and S. Scheuer. 2008. A Fresh Perspective for Managing Water in California: Insights from Applying the European Water Framework Directive to the Russian River. Water Resources Center Report 208. Available on line: http://www.lib.berkeley.edu/WRCA/WRC/pubs_contri.html#208

Kondolf, G. M. and Stillwater Sciences. 2007. Sacramento River Ecological Flows Study: Off-Channel Habitat Study Results. Technical Report prepared for The Nature Conservancy, Chico, California by G. Mathias Kondolf and Stillwater Sciences, Berkeley, California. Available online at: http://www.delta.dfg.ca.gov/erp/sacriverecoflows.asp

Gohar, A., and G.M. Kondolf. 2007. Flooding risks in El-Sheikh el-Shazli. Report to US Agency for International Development, Cairo, September 2007.

Anderson, S., R. Jencks, G.M. Kondolf, J. Natali, and G. Saraiva. 2007. New life for urban streams: strategies for revitalizing waterways in the Lisbon metropolitan region. Report published by the Department of Landscape Architecture, University of California, Berkeley, and the Luso-American Fund for Development, Lisbon, May 2007. Online at http://ies.berkeley.edu/psp/portuguesestudies/research.html#streams

Eisenstein, W., G.M. Kondolf, and J.R. Cain. 2007. *ReEnvisioning the delta: alternative futures for the heart of California.* Institute for Urban and Regional Development, University of California, Berkeley. Available online at: http://landscape.ced.berkeley.edu/~delta/

National Research Council. 2007. *Hydrology, Ecology, and Fishes of the Klamath River Basin*. (member of committee, contributed to sections on models, Klamath River, and evaluation of water balance model and instream flow model) available online at: http://dels.nas.edu/dels/viewreport.cgi?id=4794

H.T. Harvey and Associates and G. M. Kondolf. 2006. Stony Creek Watershed Assessment, Volumes I (Lower Stony Creek Watershed Analysis) and II (Existing Conditions). Report to Glenn County Resource Conservation District, Willows, California.

National Park Service. 2006. Point Reyes National Seashore Water and Aquatic Resources Stewardship Plan, Draft. (co-authored with L. Pagano, B.Ketcham, D. Vana-Miller). Point Reyes National Seashore, Point Reyes, California.

Kondolf, G.M. 2005. Expert report of Professor G. Mathias Kondolf, PhD. Submitted in NRDC et al. vs. US Bureau of Reclamation. (Assessment of restoration potential of San Joaquin River below Friant Dam, August 2005)

RECENT AWARDS AND FELLOWSHIPS

Appointed Clarke Scholar at the Institute for Water Resources, US Army Corps of Engineers, Washington DC, 2011 and 2012.

Council of Educators in Landscape Architecture. Award of Distinction, 2007.

Fulbright Commission, senior scholar research award to conduct research on environmental river management in Portugal, University of Lisbon, Mar-May 2001.

Fulbright Commission, senior scholar research award to conduct research on the Eygues River, France, 1997-1998.

RECENT PROFESSIONAL SYMPOSIA ORGANIZED

Wise Use of Floodplains: Adaptation in America and Europe

March 2012. UC Berkeley. (Organized with Anna-Serra Llobet and Scott Nicholson) This workshop explored the range of tools available for managing floodplains, from geomorphic risk-informed land-use policies and setting aside flood bypasses, to structural approaches such as construction of dams and levees, advancing a framework for 'wise use' of floodplains. Focusing on resilient communities and sustainable floodplains, the speakers drew examples from large river floodplains (mostly Sacramento and Mississippi River valleys) and from constrained urban river floodplains. Speakers included Melissa Samet, National Wildlife Federation; Chuck Shadie, USACE Mississippi Valley Division; John Andrew and Rod Mayer, California Department of Water Resources; Tim Washburn, Sacramento Area Flood Control Agency; John Cain, American Rivers; Graça Saraiva, Technical University of Lisbon; Anna Serra Llobet, UC Berkeley and formerly EU Commission Brussels; Dale Morris, Embassy of Netherlands, Washington; Ken Leep, Association of State Floodplain Managers; Mark Tompkins, Newfields River Basin Services; Jeff Romm, UC Berkeley; Todd Strole, The Nature Conservancy; Shana Udvardy, American Rivers; Rachael Marzion, Zan Rubin and Raymond Wong, UC Berkeley; Jim Fielder, Executive Director Santa Clara Valley Water District; Jack Curley, Marin County Flood Control and Water Conservation District; Ralph Johnson, Alameda County Flood Control and Water Conservation District; Mitch Avalon, Contra Costa County Flood Control and Water Conservation District; Bill DeGroot and David Mallory, Denver Urban Drainage and Flood Control District; Shana Udvardy, American Rivers; Len Materman, San Francisquito Creek Joint Powers Authority; Liang Xu, Santa Clara Valley Water District. *http://laep.ced.berkeley.edu/research/floodplains/*

Episodic Stream Channels: Imperatives for Assessment and Environmental Planning in California. November 2010. Costa Mesa, California. (organized with Kris Vyverberg of the California Department of Fish and Game and Eric Stein of the Southern California Water Resources Research Program). The purpose of this symposium was to educate the public and decision makers about the nature and importance of episodic streams, including ephemeral dryland streams and Mediterranean-climate intermittant streams. Speakers: Eric Stein, SCCWRP; Matt Kondolf; Kris Vyverberg, California Dept of Fish & Game (CDFG); Jonathan Friedman, US Geological Survey; Derek Booth, Stillwater Sciences; Brian Bledsoe, Colorado State Univ; Jeremy Lancaster, California Geological Survey; Lainie Levick, USDA; Sophie Parker, The Nature Conservancy (TBC); Barry Hecht, Balance Hydrologics; Laurel Marcus, California Land Stewardship Institute; Bill Christian, TNC; Tom Spittler, California Geological Survey; Andy Collison, Philip Williams and Associates; Katherine Curtis, US Army Corps of Engineers (USACE); Todd Keeler-Wolf, CDFG; Aaron Allen, USACE; Eric Berntsen, California State Water Resources Control Board; Deborah Hillyard, CDFG. *http://episodic.ced.berkeley.edu/*

Re-Envisioning the Delta, March 16-17, 2006, University of California, Berkeley. Speakers: Margit Aramburu, former chair Delta Protection Commission; Ronald Baldwin, San Joaquin County Emergency Operations; Joseph Bodovitz, Bay Conservation and Development Commission, Coastal Commission; Peter Bosselmann, University of California, Berkeley (UCB); Jennifer Brooke, UCB; John Cain, Natural Heritage Institute; Marci Coglianese, former mayor of Rio Vista, former member Delta Protection Commission; Joseph T. Edmiston, Santa Monica Mountains Conservancy; Phyllis Faber, University of California Press; Dan Farber, UCB Boalt School of Law; Harrison Fraker, UCB; Joseph Grindstaff, California Bay Delta Authority; Hans Johnson, Public Policy Institute of California; Patrick Johnston, Bay Delta Authority, former state senator; John King, San Francisco Chronicle; Matt Kondolf, UCB; Keith H. Lichten, P.E., San Francisco Bay Regional Water Board; Louise Mozingo, UCB; Eric Parfrey, Yolo County Planning Department; Tom Philp, Sacramento Bee; Pete Rhoads, South Florida Water Management District; Christine Rosen, UCB Haas School of Business; Raymond Seed, UCB; J. William Thompson, FASLA, Landscape Architecture magazine; Robert Twiss, UCB; Kathleen Van Velsor, Association of Bay Area Governments; Thomas W. Waters, PE, SES, US Army Corps of Engineers; Michael Webb, California Building Industry Association; Carol Whiteside, Great Valley Center; Jane Wolff, Washington University; Tom Zuckerman, University Pacific, former counsel Central Delta Water District. Program and publications online at *http://landscape.ced.berkeley.edu/~delta/*

DANNY K. HAGANS
PRINCIPAL EARTH SCIENTIST

SPECIALIZATION: *Applied geology and geomorphology, surface water hydrology, watershed assessment and restoration, erosion and sediment control, forest roads, Quaternary stratigraphy*

QUALIFICATIONS:
Principal Earth Scientist, Pacific Watershed Associates Inc., 1990-present
Geologist, Redwood National Park, Arcata, CA, 1978-1990
Mining Geologist, Western Nuclear Corp., Jeffer City, WY, 1977-1978
Geologist, Six Rivers National Forest, Eureka, CA, 1974-1975

B.S., Geological Sciences, Humboldt State University, 1978

Certified Soil Erosion and Sediment Control Specialist #494

Advisory Board, Arcata Community Forest, Arcata, CA, 1986-present
Member: Watershed Management Council
Geological Society of America
American Geophysical Union

SUMMARY OF EXPERIENCE:
Danny Hagans has extensive experience in conducting large scale, basin-wide erosion inventories and assessments, as well as implementing watershed rehabilitation and restoration projects in the western U.S. He has 12 years professional experience as a National Park Service geologist at Redwood National Park, California. During this time he worked on the development and implementation of the park's internationally recognized watershed rehabilitation program, on geomorphic research projects and on technical review of private land timber harvesting and road building proposals in the 280 mi^2 Redwood Creek watershed. He specifically investigated the role of forest land use and road construction on erosion and sedimentation on the sediment budgets of coastal watersheds and is considered a leading expert in these fields.

Since joining Pacific Watershed Associates in 1990, Mr. Hagans has managed and conducted a wide array of projects related to wildland hydrology and erosion processes, including sediment source assessments of over 2000 mi^2 of managed forest land and erosion inventories and sediment reduction plans for literally thousands of miles of wildland forest roads, ranch roads, rural subdivision roads, vineyard roads, parkland roads, and county maintained public roads. He has conducted a number of sediment source investigations for federal and state agencies, industrial forest landowners and individual private landowners. Mr. Hagans has also completed dozens of studies and erosion prevention plans for northern California Indian Tribes, State Agencies, rural subdivisions and industrial and non-industrial forest and ranch landowners. Mr. Hagans is a recognized and leading national expert in the identification and treatment of watershed erosion and sedimentation problems, especially those related to land management and road construction. He has developed and implemented numerous plans for both road upgrading and road decommissioning projects throughout Northern California. The focus of these prioritized action plans revolves around water quality and fisheries protection and restoration.

Mr. Hagans has conducted research and published articles on the magnitude and causes of forest land erosion, and especially on the effects of land use on erosion rates and processes, and cumulative watershed effects. He is co-author of two USGS Professional Papers, the "*Handbook for Forest and Ranch Roads*" (commissioned by the California Department of Forestry and the U.S. Soil Conservation Service), Chapter 10 of the CDFG Fish Habitat Restoration Manual ("Upslope assessment and restoration practices") and numerous other reports and papers. Mr. Hagans is currently serving as an appointed member of the Arcata Community Forest Advisory Committee for the city of Arcata, California.

SELECTED PUBLICATIONS:

Hagans, D.K. and Weaver, W.E., 1987, Magnitude, cause and basin response to fluvial erosion, Redwood Creek basin, northern California: International Association of Hydrological Sciences Publication No. 165, p. 419-428.

Hagans, D.K., Weaver, W.E., and Madej, M.A., 1986, Long-term on-site and off-site effects of logging and erosion in the Redwood Creek Basin, Northern California: New York, NY, National Council for Air and Stream Improvement Technical Bulletin, no. 490, p. 38-66.

Hagans, D.K., Weaver, W.E., Leroy, T.H., and Letton, B., 2006, "Stealth sediment": reducing hydrologic connectivity and fine sediment delivery from roads, an essential component to improving habitat for Central Coast steelhead [abs.], 24th Annual Salmonid Restoration Conference, Santa Barbara, CA, February 2006: Redway, CA, Salmonid Restoration Federation.

Weaver, W.E, and Hagans, D.K., 1994, *Handbook for forest and ranch roads: a guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads*: Ukiah, CA, Mendocino County Resource Conservation District, 197 p.

Weaver, W.E. and Hagans, D.K., 1996, *Sediment treatments and road restoration: protecting and restoring watersheds from sediment-related impacts*, in Healing the watershed: a guide to the restoration of watersheds and native fish in the west, 2d. ed.: Eugene, OR, Pacific Rivers Council, chap. 4, p. 109-140.

Weaver, W.E. and Hagans, D.K., 2004, *Road upgrading, decommissioning and maintenance: estimating costs on small and large scales*, in Allen, S.T., Thomson, C., and Carlson, R., eds., Salmon Habitat Restoration Cost Workshop, Gladstone, OR, November 14-16, 2000, Proceedings: Portland, OR, Pacific States Marine Fisheries Commission, p. 80-103.

Weaver, W.E., Hagans, D.K., and Popenoe, J.H., 1996, *Magnitude and cause of gully erosion in the lower Redwood Creek drainage basin*, chap. I, *in* Nolan, K.M., Kelsey, H.M., and Marron, D.C., Geomorphic process and aquatic habitat in the Redwood Creek basin, northern California: U.S. Geological Survey Professional Paper 1454, p. I1-I21.

Weaver, W.E., Hagans, D.K., Weppner, E., 2006, *Part X: Upslope erosion inventory and sediment control guidance*, in Flosi, G., Downie, S., et al., eds., California salmonid stream habitat restoration manual, 3d. ed.: Sacramento, CA, California Department of Fish and Game, 207 p.

William E. Weaver
CEO, Principal Geomorphologist

Specialization: *Process geomorphology, erosion and sedimentation processes, hydrology, watershed assessment, erosion control BMPs, forest roads, road upgrading and closure*

Qualifications:
CEO, Principal Geomorphologist, Pacific Watershed Associates Inc., 1989-present
Engineering Geologist, Redwood National Park, Arcata, CA, 1976-1989

Ph.D., Colorado State University, 1986
B.S., Geological Sciences, University of Washington, 1973

Washington Registered Geologist #2014
Washington Registered Engineering Geologist #2014

Adjunct Professor, Humboldt State University, 1988-present
Board of Directors, Humboldt County Resource Conservation District, Eureka, CA, 1994-2000
Scientific Advisory Panel, California Coastal Salmon Initiative, CA Resources Agency, 1996-97
California State Board of Forestry Task Force on forest road construction on landsliding, 1988-89
Coast Forest District Technical Advisory Committee to the California State Board of Forestry, 1976-1985

Summary of Experience:
William Weaver has more than 30 years of professional experience in the fields of process geomorphology, surface water hydrology, watershed management and engineering geology. Since forming Pacific Watershed Associates Inc. in 1989, his work has focused on forest geomorphology and the hydrologic and cumulative effects of land management and roads on forested watersheds, geomorphic processes and wetlands ecosystems. Recently his work has concentrated on water quality protection, erosion control, and fisheries restoration achieved through sediment source investigations, as well as the evaluation, planning and designing of watershed rehabilitation and sediment control activities in steepland drainage basins. As the principal Engineering Geologist at Redwood National Park for 13 years, Dr. Weaver was instrumental in designing, initiating, and monitoring the internationally recognized watershed rehabilitation and erosion control program covering the park and the 280 mi^2 Redwood Creek watershed.

Dr. Weaver has served on a number of task forces and technical committees appointed by the California State Board of Forestry to evaluate and recommend changes to the California Forest Practice Regulations covering timber harvest and road building on private forest lands. Dr. Weaver is considered a leading national expert in the field of steepland erosion processes, the impacts of road construction on watershed erosion and sedimentation processes, the effects of land management on watershed sediment yield, and the design and control of road-related erosion processes in steep, forested environments and wildland watersheds

Dr. Weaver is co-author of a book published by McGraw-Hill on experimental geomorphology and has authored a number of publications on geomorphology, watershed assessment techniques, and steep-land erosion prevention practices. His publications include a chapter on forestland gully erosion in U.S. Geological Survey Professional Paper 1454; the *Handbook for Forest and Ranch Roads*, a technical field guide commissioned by the California Dept of Forestry and Fire Protection and the U.S. Natural Resources Conservation Service; and *Part X: Upslope erosion inventory and sediment control guidance* from the California Department of Fish and Game *California*

EXPERIENCE — CONT.

Salmonid Stream Habitat Restoration Manual (3rd edition). Three additional publications, *Storm-proofing Forest Roads*, *Sediment Treatments and Road Restoration*, and *Road Upgrading, Decommissioning and Maintenance - Estimating Costs on Small and Large Scales* provide a broad range of technical procedures for water quality and fisheries protection which have been applied to road upgrading, decommissioning, and erosion control in steep mountainous watersheds of the Pacific Northwest.

Finally, Dr. Weaver is also a leading expert and technical trainer in the fields of erosion and sedimentation, erosion control, water quality protection and the management of sediment sources in wildland watersheds and along public and private roads. He conducts numerous technical training sessions and workshops on erosion processes and non-point sediment control across the state each year. Dr. Weaver is recognized for his ability to prepare and present technical, science-based workshops on topics in a manner that is easily understood by both technical and non-technical audiences, including landowners, equipment operators, land managers, regulatory personnel, environmentalists, and other scientists and consultants.

SELECTED PUBLICATIONS:

Weaver, W.E., Hagans, D.K., Weppner, E., 2006, *Part X: Upslope erosion inventory and sediment control guidance*, in Flosi, G., Downie, S., et al., eds., California salmonid stream habitat restoration manual, 3d. ed.: Sacramento, CA, California Department of Fish and Game, 207 p.

Weaver, W.W., Gerstein, J.M., and Harris, R.R., 2005, *Monitoring the effectiveness of upland restoration* [prepared for the California Department of Fish and Game Salmon and Steelhead Trout Restoration Program]: Berkeley, CA, University of California, Center for Forestry, 100 p.

Weaver, W.E. and Hagans, D.K., 2004, *Road upgrading, decommissioning and maintenance: estimating costs on small and large scales*, in Allen, S.T., Thomson, C., and Carlson, R., eds., Salmon Habitat Restoration Cost Workshop, Gladstone, OR, November 14-16, 2000, Proceedings: Portland, OR, Pacific States Marine Fisheries Commission, p. 80-103.

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Weaver, W.E. and Hagans, D.K., 1996, *Sediment treatments and road restoration: protecting and restoring watersheds from sediment-related impacts*, in Healing the watershed: a guide to the restoration of watersheds and native fish in the west, 2d. ed: Eugene, OR, Pacific Rivers Council, chap. 4, p. 109-140.

Weaver, W.E., Hagans, D.K., and Popenoe, J.H., 1996, *Magnitude and cause of gully erosion in the lower Redwood Creek drainage basin*, chap. I, *in* Nolan, K.M., Kelsey, H.M., and Marron, D.C., Geomorphic process and aquatic habitat in the Redwood Creek basin, northern California: U.S. Geological Survey Professional Paper 1454, p. I1-I21.

Pacific Watershed Associates (PWA), 1994, *Handbook for forest and ranch roads: a guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads*: Ukiah, CA, Mendocino County Resource Conservation District, 197 p.

Weaver, W.E., Sonnevil, R.A., and Klein, R.D., 1987, *Field methods used for monitoring erosion and sedimentation processes in steeplands of northwestern California*, in Beschta, R.L, Blinn, T., Grant, G.E., Swanson, F.J., and Ice, G.G., eds., Erosion and sedimentation in the Pacific Rim: Washington, D.C., International Association of Hydrological Sciences Publication No. 165, p. 509-510.

EILEEN WEPPNER
SENIOR GEOLOGIST

SPECIALIZATION: *Fluvial geomorphology, Quaternary geology, sedimentology, paleontology, watershed restoration, road erosion and sediment control, GIS, QA/QC, project management*

QUALIFICATIONS:

Senior Geologist / Watershed Division Manager, Pacific Watershed Associates Inc., 2000-present
Staff Geomorphologist / Project Geologist, Pacific Watershed Associates Inc., 1993-2000
Research and Teaching Assistant, Humboldt State University, 1992-1994
Research Assistant, Humboldt Earthquake Education Center, 1993-1995

M.S, Environmental Systems & Geology, Humboldt State University (pending thesis)
B.A., Geology, State University of New York at Buffalo, 1987

California Registered Geologist #7587
Washington Registered Geologist #1994
Oregon Registered Geologist - pending

Advanced Arcview / Spatial Analyst, 2000
Co-author, *Part X: Upslope erosion inventory and sediment control guidance*, California Salmonid Stream Habitat Restoration Manual, 3 ed., 2006.

SUMMARY OF EXPERIENCE:

Ms. Weppner has been a lead geologist for the Watershed Assessment and Restoration Division of Pacific Watershed Associates Inc. (PWA) since 2000. She is considered a leading regional expert in the assessment of road-related erosion problems, development of erosion control and erosion prevention plans, and the implementation of large scale sediment control projects for road systems in steep forested watersheds.

Ms. Weppner's professional experience includes extensive work on watershed analyses and Total Maximum Daily Load (TMDL) studies for the US Environment Protection Agency in a number of large California watersheds. For these projects she has been the lead on sampling strategy development; statistical analysis; and quality control and quality assurance for air photo analyses and field inventories of both stream channel and upslope erosional sediment sources. Ms. Weppner also has extensive experience in channel monitoring techniques, including stream channel surveying (profiles, cross sections and tag-lines), sediment sampling, scour chain installation, and photo point documentation. She has provided technical expertise to projects concerned with a range of stream channel types and scales, ranging from pre- and post-excavation surveying and monitoring of small-scale restoration sites to geomorphic channel monitoring to evaluate the impacts of dam construction.

As Senior Geologist and Manager of the PWA Watershed Division, Ms. Weppner currently oversees approximately 20 full time professional and technical personnel involved in applied research and sediment control projects, and is responsible for a full range of activities required for conducting watershed inventories and assessments for upland erosion prevention and erosion control. This includes analyzing and developing prescriptions for erosion prevention treatments; determining cost-effectiveness of erosion remediation; finalizing project layout; supervising heavy equipment operations; and managing post-project documentation and monitoring. Other duties include oversight, quality control and quality assurance, report writing, proposal writing, and public outreach for watershed related projects. In addition, she also oversees all aspects of GIS and database applications at PWA. As one of PWA's leading technical experts, Ms. Weppner also has experience presenting technical training sessions and public workshops on topics related to road management, road-related

EXPERIENCE — CONT.

erosion processes, and erosion and sediment control from public and private road systems. She is skilled in working with large groups of diverse individuals and in clearly communicating complicated topics.

One of the most recent projects managed by Ms. Weppner is the "2010-2012 Sucker Creek Sediment Source Assessment and Sediment Control Plan, Rogue River-Siskiyou National Forest, Josephine County, Oregon" conducted in 2009-2010 and 2011-2012 for the Pacific Rivers Council and the US Department of Agriculture, Rogue River-Siskiyou National Forest. The two projects involved a field based "forward-looking" erosion assessment of over 209 mi of forest roads within the portion of the Rogue River-Siskiyou National Forest (RRSNF) located in the Sucker and Grayback Creek watersheds, Josephene County, Oregon. Final work products included an analysis of the roads within the Grayback Creek watershed by age and geomorphic location, summary of field identified road related erosion and sediment delivery problems, development of a prioritized site specific erosion prevention plan including treatments and prescriptions for reducing chronic sediment delivery. Over 750 sites were identified and prescribed for erosion and sediment control through both road upgrading and road decommissioning treatments. The final report also included recommendations for developing a transportation plan for the Grayback Creek watershed that is aimed at identifying the long term road network that will be retained for management and public access, as well as those roads that are either unneeded for management or represent a high risk for future sediment impacts to downstream aquatic resources and water quality.

SELECTED PUBLICATIONS:

Weppner, Eileen M., 2009, Comparison of slope stability models derived from 1m DEM, Freshwater Creek and Ryan Slough watershed, Humboldt County, California, Abstracts with Programs, GSA Annual Meeting, Portland, OR.

Watt, C.L., Hagans, D.K., Weppner, E.M., and Lew, W.R., 2007, Road-related sediment delivery volumes derived from a "forward-looking" erosion assessment, Hollow Tree Creek watershed, Mendocino County, California [abs.]: Geological Society of America, Cordilleran Section Annual Meeting, 103rd, Bellingham, WA, May 4-6, 2007. Available from: http://gsa.confex.com/gsa/2005CD/finalprogram/abstract_85680.htm

Weaver, W.E., Hagans, D.K., Weppner, E., 2006, *Part X: Upslope erosion inventory and sediment control guidance*, in Flosi, G., Downie, S., et al., eds., California salmonid stream habitat restoration manual, 3d. ed.: Sacramento, CA, California Department of Fish and Game, 207 p.

Leroy, T.H., Weaver, W.E., Weppner, E.M., and Kraemer, T.W., 2005, Evaluation of stream crossing decommissioning techniques and effectiveness for a regional watershed restoration program [abs.], Geological Society of America, Cordilleran Section Annual Meeting, 101st, San Jose, CA, April 29-May 1, 2005. Available from: http://gsa.confex.com/gsa/2005CD/finalprogram/abstract_85765.htm

Weppner, E.M., and Hagans, D.K., 2005, Methodology to estimate sediment sources for Total Maximum Daily Load studies, Van Duzen River, Humboldt County, California [abs.] Geological Society of America, Cordilleran Section Annual Meeting, 101st, San Jose, CA, April 29-May 1, 2005. Available from: http://gsa.confex.com/gsa/2005CD/finalprogram/abstract_85748.htm

Weppner, E.M., 2003, New methods for diagnosing and managing upslope sediment sources at the watershed scale, Napa River Basin, Napa County [abs.]: Sacramento, CA, CALFED Bay-Delta Program Biennal Science Conference, 2nd, Jan 14-16, 2003.

Annex 2

Costa Rican Ministry of Environment, Energy and Telecommunications, National Conservation Area System, Ministry of Public Works and Transportation, National Road Council, and National Risk Prevention and Emergency Response Commission, "Environmental Management Plan: Juan Rafael Mora Porras Road".

April 2012

Government of Costa Rica

WE ARE BUILDING
A SAFE COUNTRY

ENVIRONMENTAL MANAGEMENT PLAN

Juan Rafael Mora Porras Road

Ministry of Environment, Energy, and Telecommunications

National Conservation Area System

Ministry of Public Works and Transportation

National Road Council

National Risk Prevention and Emergency Response Commission

April 2012

Table of Contents

1. Introduction

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

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

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

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

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

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

2. Description of the Area of the Road Construction Project

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

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

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

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

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

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

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

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

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

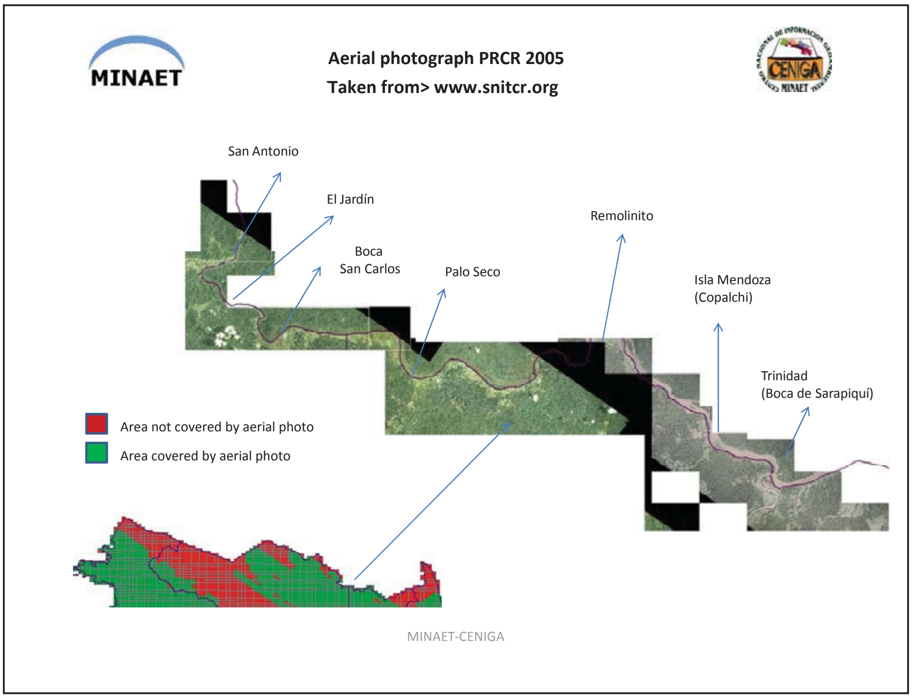


Figure N1 Aerial photograph analysis carried out by CENIGA to identify impacts on the northern border corridor, based on aerial photographs taken in 2005.

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

3. Impact Assessment

3.1. Methodology

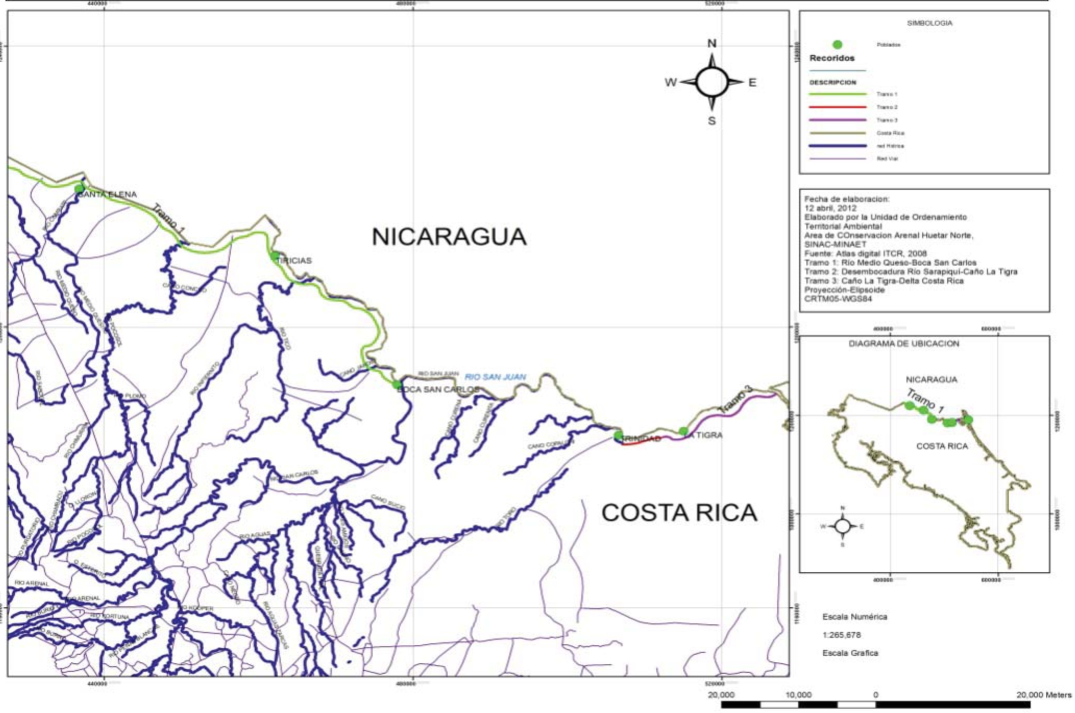
For the purpose of assessing potential environmental impacts caused by road construction, a team was created with officials from the Ministry of Environment, Energy, and Telecommunications (MINAET), which according to Article 5 of Forestry Law N° 7575 is the sector-governing agency responsible for state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

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

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

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

LOCATION OF GRAVEL ROAD IN NORTHERN COSTA RICAN BORDER CORRIDOR



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

3.2. Environmental Impacts Identified Through Visual Assessment and Expert Criteria

3.2.1. Assessing Impacts on Biodiversity, Ecosystems, and Soils

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

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

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

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

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

4. Sediment traps under implementation in rainwater drainage canals.

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

6. Minor changes in the course of some streams.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2.2. Identifying and Assessing Bodies of Water

This activity was performed by MINAET's Water Directorate.

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

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

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

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

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

The bodies of water identified and assessed are listed below:

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

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

The bodies of water identified and assessed are listed below:

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

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

The bodies of water identified and assessed are listed below:

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

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

The bodies of water identified and assessed are listed below:

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

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

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

3.3 Summarized Impacts and Recommended Environmental Measures

3.3.1. WATER RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

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

PROPOSED AND ONGOING ENVIRONMENTAL MEASURES

1. Building road cross-cutting drainages through the Medio Queso wetland to partially restore natural flow and direction of water running parallel to both banks of the Medio Queso River.
2. Plantations with native local species should be established to protect river and brook banks, particularly in areas without any forest cover, on the entire land strip between the road and the San Juan River.

~~3.~~ Hydrological studies should be made for all water crossings to determine design flow rates in order to identify required hydraulic works capacities.

4. To the extent possible, keeping natural waterbody hydraulic sections at the time of hydraulic works installation and providing inlet and outlet structures to facilitate channel flow transition to and from the structure to be installed.

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

3.3.2 FOREST AND WILDLIFE RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Removal and alteration of vegetation cover.
2. Use of uprooted tree trunks as crossings over brooks and streams.
3. Increased demand for natural resources, plant and wildlife extraction.
4. Possible wildlife displacement route alteration.
5. Risk of wildlife being run over by vehicle traffic.

PROPOSED ENVIRONMENTAL MEASURES

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

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

3.3.3 SOIL RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

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

PROPOSED ENVIRONMENTAL MEASURES

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

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

3.3.4 AIR RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Noise generation that could impact wildlife.

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

PROPOSED ENVIRONMENTAL MEASURES

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

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

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

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

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

3.3.5 SOLID AND LIQUID WASTE MANAGEMENT

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Risk of potential impacts on wildlife and plants.

2. Risk of potential impacts on bodies of water.

3. Risk of potential impacts on soils.

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

5. Risk of potential pollution from liquid waste generation.

PROPOSED ENVIRONMENTAL MEASURES

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

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

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

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

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

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

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

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

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

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

3.3.6 HISTORICAL AND ARCHAEOLOGICAL HERITAGE

IDENTIFIED ENVIRONMENTAL IMPACTS

1. Impacts on potential archaeological discoveries.

PROPOSED MEASURES

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

3.3.7 SOCIOECONOMIC RESOURCE

IDENTIFIED ENVIRONMENTAL IMPACTS

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

PROPOSED ENVIRONMENTAL MEASURES

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

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

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

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

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

4. References

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

Annex 1 Members of the Institutional Commission

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

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

	Source	Location		Recommended Works	Priority
		Latitude	Longitude		
Report AT-0102-2012, from marker 1, latitude coordinate: 330.447 and longitude coordinate: 496.953 to approximately 1 km before the mouth of the Infiernito River, latitude coordinate: 321.635 and longitude coordinate: 501.461	1	325.147	498.710	Drain overpath, sediment traps	
	5	324.226	499.556	Drain crossing or bridge, sediment traps, entrance and exit structures	
	8	323.553	499.777	Drain crossing or bridge, sediment traps, entrance and exit structures	
	11	322.866	500.257	Drain crossing or bridge, sediment traps, entrance and exit structures, energy dissipator.	
	17	325.981	497.649	Bridge, sediment traps	
	19	328.501	498.470	Drain crossing, sediment traps	
	25	329.831	497.435	Drain crossing or bridge, sediment traps, entrance and exit structures	
	1	334.341	461.138	Should be analyzed with the respective SINAC since the area under study corresponds to wetlands	
	4	337.157	466.590	drain overpass or bridge, energy dissipators, sediment traps	
	6	336.179	473.657	Bridge, sediment traps	
	7	335.489	474.031	Drain crossing, sediment traps	
	8	335.151	472.215	Drain crossing, sediment traps	
	9	334.383	475.121	Drain crossing, sediment traps	
	10	333.855	467.317	Drain crossing, sediment traps	
	11	333.730	476.619	Drain crossing, sediment traps	
	12	333.508	477.186	Drain crossing, sediment traps	
	13	333.094	478.171	Drain crossing, sediment traps	

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

	Source	Location		Recommended Works	Priority
		Latitude	Longitude		
Report DA-0173-2012, from the plains of the Medio Queso River, latitude coordinate: 334.543 and longitude coordinate: 460.560 up to Estrecho Machado, latitude coordinate: 307054 and longitude coordinate: 521685	15	332.861	478.755	Drain crossing, sediment traps	
	19	332.287	480.125	Drain crossing, sediment traps	
	21	331.956	480.901	Drain crossing, sediment traps	
	22	331.932	480.97	Drain crossing, sediment traps, energy dissipators	
	23	331.756	481.422	Drain crossing, sediment traps, energy dissipators	
	24	331.628	481.741	Drain crossing, sediment traps, energy dissipators	
	25	331.45	482.15	Drain crossing, sediment traps, energy dissipators	
	1	326.096	490.429	Drain crossing or bridge, sediment traps	
	2	326.581	490.915	Drain crossing or bridge, sediment traps	
	3	326.821	491.163	Drain crossing, sediment traps, energy dissipator	
	4	327.715	492.039	Drain crossing, sediment trap	
	5	327.906	492.212	Drain crossing, sediment trap	
	6	328.1	492.414	Drain crossing, sediment trap	
	7	328.238	492.696	Drain crossing or bridge, sediment traps	
	1	307.449	516.231	Drain crossing, sediment traps, energy dissipators	
	2	307.287	516.991	Drain crossing, sediment traps, energy dissipators	
	3	307.247	517.478	Drain crossing, sediment traps, energy dissipators	
	4	307.252	517.732	Drain crossing, sediment traps	
	5	307.216	518.579	Drain crossing, sediment traps, energy dissipators	

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

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

ANNEX 2, RECOMMENDED WORKS BY TYPE OF SOURCE

Source	Location		Recommended Works	Priority
	Latitude	Longitude		

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

Interpretation of previous matrix: The tables are divided in three sections, depending on the reports issued by this Directorate (AT-0102-2012, DA-0173-2012 and DA-0171-2012).

The main mitigation works recommended are:

Adequate drain crossings or bridges according to the hydraulic and hydrological characteristics of the site, endeavoring to maintain hydraulic sections of sources, in order to reduce downstream and upstream impact by the structures to implement, preventing any impact resulting from water and debris accummulation that could cause flooding in the zone due to overflowing on both sides of the banks during high precipitation periods.

The entrance and exit works seek to facilitate drainage of water flowing from the channel to the structure to install, or vice versa, thus reducing the impact resulting from erosion in transition sections.

Energy dissipators seek to mitigate the impact by reducing speed of the flow that could be erosive. This permits to minimize transportation of sediments from the channels to the San Juan River, for which sediment traps have been recommended.

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

ANNEX 3. SUMMARY OF ENVIRONMENTAL MANAGEMENT PLAN ACTIONS - ROUTE 1856

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

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

Annex 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.

Laboratorio Nacional de
Materiales y Modelos Estructurales

REPORT: INF-PITRA-014-12

REPORT ON RECONNAISSANCE TRIP TO ROUTE 1856 – JUAN RAFAEL MORA PORRAS

BORDER TRAIL

Prepared by:

Transport Infrastructure Program

PITRA-LannameUCR

San José, Costa Rica
May 2012

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Conditions observed during the reconnaissance trip to Route 1856 – Juan Rafael Mora Porras (Nicaraguan Border Trail) on May 8th, 9th, and 10th, 2012 are presented in this report. The reconnaissance took place in 9 road segments between different sites adjacent to the north border: variable conditions were found in both work implementation and progress .
The document shows issues considered relevant to current project status on basic road engineering aspects, such as: drainage, materials used, earthmoving, waterbody management, embankment works, building of fills, and erosion and surface water mitigation measures.</td></tr>
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CONTENTS

1 RATIONALE

This report summarizes observations made in a reconnaissance trip taken by LannameUCR officials to Route 1856 Juan Rafael Mora Porras on account of this project being relevant to the country and in view of resources invested in its implementation. LannameUCR actions are carried out pursuant to provisions in Article 6 of Law N° 8114 on Tax Simplification and Efficiency and its reform through Law N° 8603, within National Laboratory of Materials and Structural Models (LannameUCR)'s Program for Monitoring National Road Network Quality.

2 GENERAL OBJECTIVE

Taking a reconnaissance and visual assessment field trip to the border road, National Route N° 1856 Juan Rafael Mora Porras, with the purpose of technically assessing construction works thus far implemented as to their configuration, quality, and functionality.

3 SCOPE

Approximately 97 kilometers were traveled along the route between Delta Costa Rica and the Pocosol River performing a visual assessment of the most relevant components and activities taking place in this road construction project, including: road layout, earthmoving (cuts and fills), road surface granular material, drainages (gutters and culverts), and bridges. This assessment did not include any kind of laboratory testing or technical inspections on specific issues.

The trip focused on the border trail, and therefore no mention is made of access roads where construction and improvement works have been implemented.

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Based on best road engineering practices for this kind of works, this report expresses a general technical criterion on the condition found in border trail construction works. Professionals that took the trip to the project and undersigned this report are highly trained in road engineering and thus capable of identifying a road basic condition through visual inspection. The intent is not at all to substitute for the rigor of a technical audit documentary review, or forensic engineering components, or laboratory studies but rather to provide a first insight on project condition. Hence, information shown in this document may be used by Management as an initial guiding input in implementing end-product improvement actions to prevent performance problems prior to road operations.

4 BACKGROUND

Construction of the road "Route 1856 Juan Rafael Mora Porras" was announced in December 2010 by authorities of the Government of Costa Rica to protect national sovereignty and as a permanent solution allowing free traffic of both people and agricultural products in Costa Rica's north border region, more specifically in the territorial area running parallel to the San Juan River. Thus, a state of emergency was declared through Executive Decree N° 36440-MP in counties bordering Nicaragua, enabling the Executive Branch to use National Emergency Commission's funds and receive assistance from several State institutions, including the National Road Council (CONAVI).

The above mentioned Executive Decree supported the implementation of various infrastructure works meant to facilitate traffic and land transportation between communities in the northern part of the country through a road construction project, running adjacent to the San Juan River, which would additionally provide surveillance of said border zone.

5 DESCRIPTION AND LOCATION

Visual inspection of Route 1856 consisted of a reconnaissance trip taken from May 8th to 10th, 2012. A total of approximately 97 km were traveled along the "Border Trail". In order to provide a clearer description of observed details the route was divided into nine sections of different lengths. Road condition, topographic characteristics, and visible changes in work fronts were taken into account in making this division. A table describing each road section is shown below.

Table 1. Detail of Road Section Breakdown

Name	Length	Description
Section 1	15 km	Delta Costa Rica-Fátima
Section 1	9 km	Fátima-Sarapiquí River Mouth
Section 1	9 km	Copalchí-Remolinito
Section 1	7 km	Remolinito-Cureña
Section 1	19 km	Cureña-San Carlos River Mouth
Section 1	12 km	San Carlos River Mouth-Infiernito River
Section 1	6 km	Infiernito River-Quarry in Tiricias
Section 1	13 km	Quarry in Tiricias-San Isidro de Pococí Junction
Section 1	7 km	San Isidro de Pococí Junction-Pocosol River

The figure below shows the spatial location of the different road sections, as well as access routes used and benchmarks. It is worth pointing out road sections on the map have the following nomenclature: T1 = Section 1, T2 = Section 2, and so forth until Section 9.

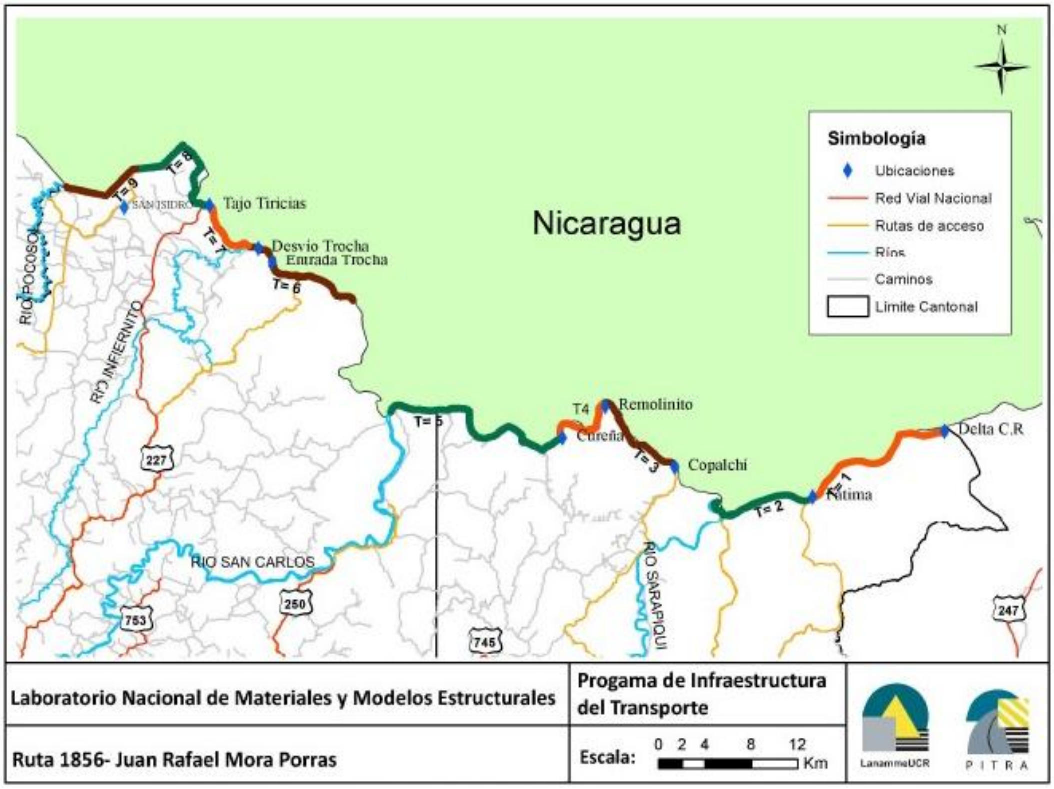

Figure 1. Route 1856-Juan Rafael Mora Porras Layout
Source: LannameUCR, May 2012.

The "Trail" was traveled in an east-west direction during the first day beginning at Delta Costa Rica, going through the town of Fátima until reaching the Sarapiquí River Mouth. The trail is interrupted at this point because a bridge of at least 200 meters needs to be built over the Sarapiquí River channel.

On the second day we entered through a town known as Copalchí. The journey followed an east-west direction going through the towns of Remolinito and Cureña until the San Carlos River Mouth was reached; in this sector a bridge of approximately 250 meters also needs to be built in order to cross the San Carlos River. Unable to continue on this route, we had to cross the San Carlos River somewhere else.

On Day 3 we went through the town known as San Isidro until we reached the Pocosol River on Route 1856. From this point onwards we traveled in a west-east direction going through the junction towards San Isidro, the quarry (*tajo*) located at Tiricias (Tajo Tiricias on the map), and the Infiernito River until we reached the starting point of road section 6. This means that between this point and the San Carlos River mouth there are approximately 30 kilometers that we did not traveled on account of its difficult access. As a result, the team submitting this report does not know the condition in this area or the quality of works carried out there.

6 OBSERVATIONS MADE DURING THE TRIP

6.1 Road Section 1 Delta Costa Rica-Fátima (15 km)

This section encompasses works from Delta Costa Rica to the intersection with Fátima. This road section is approximately 15 km in length and the area has a predominantly flat topography (see Figure 2).

Figure 2. Condition of platform in road section 1.
Source: LannameUCR, May 2012.

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A well-consolidated platform was observed with presence of isolated holes. This road section already exhibits a slight camber loss, and a roadside segregation of fines was found, along with the presence of oversize materials (see Figure 3).

Figure 3. Section 1 crown condition
Source: LannameUCR, May 2012.

The typical cross-section of this road segment reveals a crown measuring approximately 4 meters with ditches on both sides. The oversize material piling up at road crown sides, however, could hinder surface water drainage into the ditches.

Erosion control vegetation was also seen in ditches, thus requiring maintenance tasks to control plant growth (see Figure 4).

Figure 4. Condition of gutters in road section 1.
Source: LannameUCR, May 2012

6.2 Road Section 2. Fátima-Sarapiquí River Mouth (9 km)

This road section in approximately 9-km long and encompasses works from Fátima to the mouth of the Sarapiquí River.

A double-simple Bailey bridge is found at the beginning of this road section. The bridge is in poor operating condition with severely rusted superstructure and major floor damages. Additionally, it exhibits an offset from the original alignment likely caused by overloads, and structure support points are not rigid bastions, which may result in large shifts (see Figures 5 and 6).

Figure 5. Bailey bridge on Fátima-Sarapiquí River Mouth road section.
Source: LannameUCR, May 2012

Figure 6. Bailey bridge supports in Fátima-Sarapiquí River Mouth road section.
Source: LannameUCR, May 2012

This road section has a stronger presence of oversize material[1] and a more heterogeneous aggregate matrix making up the road surface. In addition, the platform is not fully consolidated and shows bigger deformations (mostly undulations) at the crown (see Figure 7).

In some areas of this road section the crown is below the natural terrain level, holes are more common, and both deformations and granular material segregation are much more severe. It is also evident the granular material used is already contaminated with material from the subgrade (see Figure 8).

Figure 7. Deformations and contaminated granular material
Source: LannameUCR, May 2012

[1] The term "oversize material" refers to stone aggregates having rocks larger in size than maximum required by technical specifications.

Figure 8. Holes and material contaminated with subgrade.
Source: LannameUCR, May 2012

In addition, the platform is not properly shaped since some granular material is segregated at the sides, with oversize materials encouraging segregations and loss of material (see Figures 9 and 10).

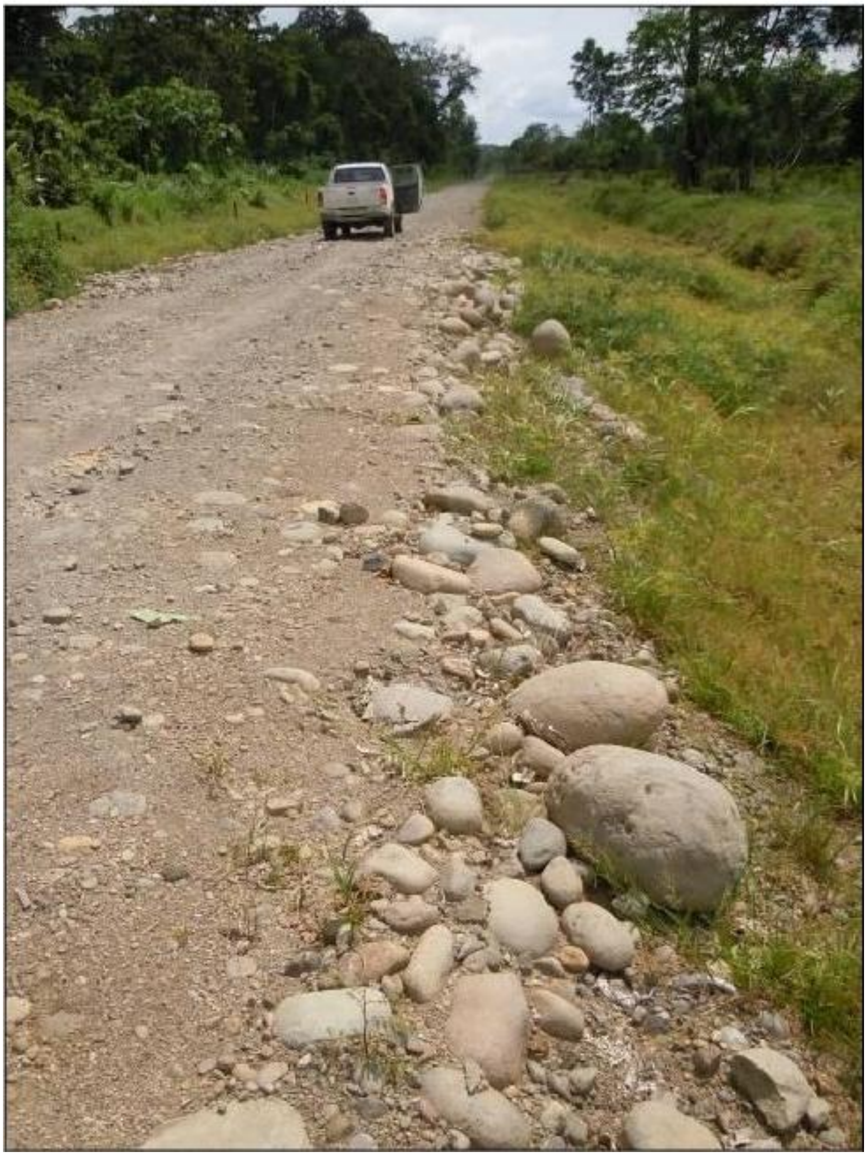

Figure 9. Current platform condition, road section 2.
Source: LannameUCR, May 2012

Figure 10. Oversize material piled up at roadside.
Source: LannameUCR, May 2012

Approximately 7 km of this road section have cuts and fills with close to 10% slopes. Problems were found concerning surface water drainage and an absence of gutters (see Figure 12). Additionally, based on visual inspection, it could be assumed no fill layer compaction was done since the material is very loose in much of the existing platform.

Since cut embankments in this road section exhibit almost vertical angles, it is advisable to assess soil characteristics and check whether angles are suitable to insure overall stability (see Figure 11).

Figure 11. Cut and fill areas, road section 2.
Source: LannameUCR, May 2012

Figure 12. Nonexistent side drainage structures.
Source: LannameUCR, May 2012

6.3 Road Section 3 - Copalchí-Remolinito (9 km)

Works done along this approximately 9-km long road section are at the embankment stage in some sectors, while there are also areas where only right-of-way clearing tasks have been performed.

The typical cross-section consists of a variable size subgrade with a right-of-way up to 20-meters wide (see Figure 13) without gutters or roadside drainage ditches to channel surface water.

Figure 13. Fill section, road section 3.
Source: LannameUCR, May 2012

Apparently, the soil used for filling has a moderate to high plasticity, which resulted in its becoming cracked due to shrinkage (see Figure 14). This type of soil usually lacks the mechanical properties that would make it suitable for use as a subgrade material.

Figure 14. Soil cracking, road section 3
Source: LannameUCR, May 2012

Some sectors were found to have fills up to 1.5 m in height, and apparently no layer compaction (a normal practice for this kind of works) was done because the material was found to be very loose with evidence of sliding down at the sides (see Figure 15).

Figure 15. Fill with evidence of material sliding down from platform, road section 3
Source: LannameUCR, May 2012

Cuts and fills in mountainous areas were done without following any orderly system. Several sectors have stockpiles of materials not conforming to the basic criteria for debris disposal site or embankment management (see Figure 16).

Figure 16. Earthmoving areas in road section 3.
Source: LannameUCR, May 2012

Near the end of this road section no works have been done to shape the platform, place drainages, or other tasks. High moisture conditions were observed, along with the possible presence of a shallow ground water level (see Figure 17).

Figure 17. Sector without intervention, high ground water levels, road section 3.
Source: LannameUCR, May 2012

6.4 Road Section 4. Remolinito-Cureña (7 km)

This approximately 7-km-long road section goes through a variable topography area mostly with some rugged terrain and some flatland sectors. The main works in this section consist of cuts and fills. There is a constant presence of clayey subgrade material likely to have moderate to high plasticity levels.

The topography of many sectors along this road section and the way earthmoving has been done (particularly cut angles), coupled with mechanical properties of the material, favor instabilities that could easily lead to serious landslide problems caused by rain during months of heaviest precipitation (see Figure 18).

Fig. 18. Landslides in the Route, road section 4
Source: LannameUCR, May 2012

A relevant observation concerning Route 1856 construction is the way several fills have been built, in terms of both their undue height and the poor evidence of a mechanical layer compaction process, as mandated by best engineering practices. These areas are particularly vulnerable to damage during the rainy season (see Figure 19).

Figure 19. Fills found in road section 4.
Source: LannameUCR, May 2012

Sand layers were found laid over some sectors in this road section. While the purpose of laying this material remains unknown, a material capable of consolidating the travel platform would obviously have been desirable at this stage of the project. Sand will not perform this function and it is therefore deemed to have little value for project purposes. Sand properties themselves were the reason several areas are already exposed on account of run-off water or machinery traffic (see Figure 20).

Figure 20. Sand laid over the subgrade in road section 4.
Source: LannameUCR, May 2012

An area with poor management of cut material was noticed in this road section, since the material was laid next to a body of water without any control. This is a totally inadequate practice, from both the construction and engineering point of view, that damages not only this body of water but also Route 1856, since there is no erosion control to prevent loss of material under rainy conditions (see Figure 21). Placing a properly designed and chosen geotextile could help control erosion in this embankment. This, however, does not exempt from the responsibility for making sure slope compaction was done adequately, according to current specifications.

Figure 21. Inadequate cut material and embankment management.
Source: LannameUCR, May 2012

After passing the mountainous terrain, near the site known as Cureña, a better condition was found in both road platform and materials laid to shape the current road surface. Laid and compacted aggregates present a good configuration for traffic. Some areas that experienced "settling" during the construction process were identified (see Figure 22).

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Figure 22. Material laid on the Route in the Cureña sector.
Source: LannameUCR, May 2012

6.5 Road Section 5. Cureña-San Carlos River Mouth (19 km)

This sector exhibits a subgrade near the natural terrain level with minor cuts and fills present. No roadside gutters or any other drainage system to channel surface run-off water were seen. In addition, the road does not have the camber required to properly drain water (see Figure 23).

Figure 23. Subgrade level in road section 5.
Source: LannameUCR, May 2012

At the end of this road section, near the San Carlos River mouth, some sand banks were found. This sand has very similar properties to the material used as road surface in section 4, which leads to the assumption this is a supply area for the sandy material previously observed (see Figure 24).

Figure 24. Subgrade level in road section 5.
Source: LannameUCR, May 2012

This sandy material does not have the properties required to help consolidate the platform or to be used as road surface finish, given it is a very fine material easily erodible by water or wind, as well as by road traffic. This will result in said material being segregated to roadsides (see Figure 25).

Figure 25. Sandy material supply in road section 5.
Source: LannameUCR, May 2012

6.6 Road Section 6. San Carlos River Mouth-Infiernito River (12 km)

Road section 6 is approximately 12-m long going from the San Carlos River mouth to the Infiernito River. This border road section has a predominantly rolling topography with slopes steeper than 20%. The road cannot be traveled in a continuous fashion in this area because no granular material has yet been placed on the road surface, and there are sectors where use has to be made of alternate roads that seem to have been conditioned to move machinery between the different work fronts.

As a result of terrain topography, large earthmoving (cut and fill) operations visibly unfinished in many sectors have been performed. These areas need to be traveled at slow speed and very cautiously because there is only one lane with steep grades and loose material, as seen in Figure 26.

Figure 26. Cut and fill area, road section 6.
Source: LannameUCR, May 2012

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In cut areas no properly shaped embankments with slopes suitable to the existing soil type were observed. As a result, many of them look unstable and therefore susceptible to landslides, particularly in the rainy season. We did not see any slope protection or impermeabilization measures implemented to help decrease moisture impact during high rainfall events. Figure 27 shows a cut embankment with evidence of incipient landslides in some areas.

Figure 27. Unstable cut embankment, road section 6.
Source: LannameUCR, May 2012

The fill material used to shape the road platform does not seem to have undergone any adequate compaction process. Said material appears loose in most sectors. Figure 28 shows a fill area with loose material eroded by storm water drainage.

Additionally, some tree trunks or brush from right-of-way clear-cutting have been placed on embankment or fill sides, seemingly acting as brush fences to retain sediments, which is a desirable practice. This erosion control measure, however, was seen only in some sectors and without entirelly covering the fill area. Figure 9 shows tree trunks and brush laid at a fill embankment foot.

Figure 28. Fill area, road section 6.
Source: LannameUCR, May 2012

Figure 29. Brush and tree trunks laid at embankment foot, road section 6.
Source: LannameUCR, May 2012

Figure 30 shows an alternative road bypassing the Route where the main construction works are taking place and, hence, where no traffic is currently possible. This road is located at an area with a very rugged terrain.

Figure 30. Alternate road bypassing the Route, road section 6.
Source: LannameUCR, May 2012

Figure 31 shows an area with unfinished works. In this sector of the road a right-of-way wider than 50 meters has been cleared following a layout parallel to the San Juan River, despite the existence of a markedly rugged terrain. As a consequence, earthmoving operations are extensive and more complicated on account of steep slopes and soil type. Surface run-off impact is noticeable in the development of gullies eroding the soil of embankments and therefore destabilizing them.

A water course was found at the bottom of the mountain, where a stream crossing should be built, in accordance with existing flow characteristics, to decrease sediment load and changes in the natural channel as much as possible.

Figure 31. Cut and fill area in mountainous zone, road section 6.
Source: LannameUCR, May 2012

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6.7 Road Section 7. Infiernito River-Quarry in Tiricias (6 km)

This road section runs parallel to the San Juan River and has a topography characterized by several gently rolling climbs all the way to the quarry in the Tiricias area. Road surface condition was found to be generally good, with presence of granular material possibly coming from the rock crusher located nearby.

At the beginning of this road section there is a log structure allowing passage over the Infiernito River. A large amount of rocky material piled up on the river's left bank has reduced the hydraulic cross-sectional area to less than half, thus hindering water flow. Although this structure is temporary, it could obviously sustain serious damage from river overflow inasmuch as a blocked natural channel would result in increased flow speed, which could undermine and jeopardize the approach fill (see Figure 32).

Figure 32. Log bridge over Infiernito River. Reduced hydraulic cross-sectional area.
Source: LannameUCR, May 2012

One of the issues of greatest concern is the poor management of waterbodies crossed by the route. Due to to the kind of area where works are taking place (wetland), the road layout sometimes comes across meanders that have not been channeled and which could erode the platform in the short term and cut the road at multiple points.

This is not only inadequate for the route itself but also causes a negative impact on these bodies of water, limiting oxygenation capacity and degrading water quality as a result of stagnation (see Figure 33).

Figure 33. Blocked bodies of water.
Source: LannameUCR, May 2012

Managing surface and run-off water is one of the main issues to be taken into account in constructing this kind of road. Inadequate stream-crossing construction methods were seen at many points in this road section and in other sectors. While admittedly the project is at the initial implementation stage, this is precisely the best time to build structures aimed at meeting these requirements. Examples like the one shown in Figure 34 attest to the poor management of this issue in the project.

Figure 34. Logs used for stream crossing in road section 7.
Source: LannameUCR, May 2012

Road surface materials come from different sources. At some points these materials were seen to be taken from some channel excavation; however, materials extracted from some sort of quarry were also identified. In this road section, for instance, there is an operating quarry that apparently has not followed a staged extraction process (typical and mandatory for these sites), thus facilitating nearby waterbody erosion and sedimentation processes (see Figure 35).

Figure 35. Road surface material extraction site.
Source: LannameUCR, May 2012

Some points along this road section exhibit a woven material ("saran" type) laid over slopes. This material may reduce rain and wind erosion but will not decrease the amount of sedimentation because it is not a nonwoven geotextile capable of retaining these sediments. In addition, since the material has been placed in a scattered manner it is not significantly effective (see Figure 36).

Figure 36. Scattered placing of woven material on slopes.
Source: LannameUCR, May 2012

6.8 Road Section 8. Quarry in Tiricias-San Isidro (13 km)

Road section 8 goes from an area close to Tiricias to San Isidro de Pocosol. This sector has a rolling topography and runs adjacent to the Nicaraguan land border in most of its length.

Travel on road section 8 started at a materials mining site or quarry. As seen in Figure 7, the top of a rock mass located within Route 1856 corridor has been mined. Materials extracted from this quarry are processed by a rock crusher to produce aggregates for road plaform and surface. This is a good practice because it prevents overhauling and placing of poor quality and oversize aggregates.

Figure 37. Quarry located near Tiricias, road section 8.
Source: LannameUCR, May 2012

In sectors were saran fabric was placed seemingly to protect slopes, as shown in Figure 38, designing and placing geotextiles would have been most advisable, as recommended by best engineering practices.

Figure 38. Saran fabric placed on cut and fill slopes, road section 8.
Source: LannameUCR, May 2012

While traveling along Route 1856, most of the soil resulting from cuts was seen side-cast in fill areas, a desirable practice since it eliminates the need for building debris disposal sites. In road section 8, however, an excavated material disposal mound was seen on a mountain slope, which could create stability problems and contribute sediments to nearby bodies of water during the rainy season, as shown in Figure 39.

Figure 39. Excavated material mound, road section 8.
Source: LannameUCR, May 2012

One particular issue along Route 1856 road section 8 is the presence of numerous streams in mountain and forest zones. Small rivers or brooks are found approximately every 200 meters, and provisional drainage measures have been implemented only in some cases, given there are sites where fills have entirely blocked watercourses. Figure 40 shows tree trunks placed as a provisional measure to enable vehicle road traffic at a stream crossing. Natural water flow can be seen becoming plugged and water starting to accumulate at the upstream side of the crossing. This type of provisional measures should be replaced as soon as possible with culverts properly designed according the each stream flow rate to prevent eventual road embankment damage during the rainy season.

Figure 40. Provisional log stream crossing, road section 8.
Source: LannameUCR, May 2012

Granular material found at the end of road section 8 is likely to come from the above mentioned quarry and apparently has good properties to be used as road surface aggregate, on account of its chiseled shape, absence of oversize, good compaction, and conformation. Figure 41 shows the area where road surface granular material was starting to be laid on this road section.

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Figure 41. Beginning of area with granular material, road section 8.
Source: LannameUCR, May 2012

Some unstable slopes were observed on account of cuts made at angles unsuitable to soil typel, which has resulted in some points exhibiting landslides as the one shown in Figure 42.

Figure 42. Slope landslides in cut areas, road section 8.
Source: LannameUCR, May 2012

Additionally, there are areas where sectors over 50-meters wide have been cleared as right-of-way, which has increased the magnitude of earthmoving and road surface aggregate laying operations. Figure 43 shows, for instance, an area of road section 8 where road surface has been split in two lanes to bypass an existing tree, to the detriment of a better choice such as entirely shifting the road layout to one side and thus decreasing forest disturbance, as well as the amount of earthmoving and materials.

Figure 43. Road section bypassing existing trees, road section 8.
Source: LannameUCR, May 2012

6.9 Road Section 9. San Isidro de Pocosol-Pocosol River (7 km)

This road section is characterized by a primarily flat topography aligned according to borderline milestones. Approximately half of this road section is covered by a less than 5-cm-thick layer of granular material, unsuitable to platform consolidation, that would obviously be carried away by run-off water, despite currently being in acceptable condition for vehicle traffic (see Figure 44).

Figure 44. Inadequate road surface granular material on section 9.
Source: LannameUCR, May 2012

Plastic Rib-Loc pipes cutting across under road platform were found at several stream crossings. It is evident, however, these pipes were not properly installed since they lack reinforcing end structures and a granular material bed to prevent pipe bottom

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deformations. Fills over 3-meter-high were found at some points above these pipes, which has led to pipe deformation and reduced hydraulic capacity (see Figure 45).

Figure 45. Poorly installed Rib-Loc pipes.
Source: LannameUCR, May 2012

The use of cargo containers as square culverts was noticed at some points along this road section. Obviously, a nonexistent foundation and loads from fills have caused major deformations in these structures since they were not designed for this purpose. This is not deemed to be an adequate solution for stream crossings since there is no assurance these elements will be able to withstand a significant flow rate without resulting in fill loss (see Figure 46).

Figure 46. Containers used as square culvert pipes.
Source: LannameUCR, May 2012

Fills up to 3- meters high with edges breaking down onto adjacent terrain were found in several sectors of this road section indicating they were not built according to suitable compaction processes. Additionally, an absence of drainage structures in several sectors may lead to losses in platform cross-section from run-off water action (see Figure 47).

Figure 47. Fill areas without drainage structures.
Source: LannameUCR, May 2012

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7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Conclusions

- In approximately 97 kilometers traveled along the Border Trail between Delta Costa Rica and the Pocosol River, 9 road sections were identified as being in unequal condition:

  -<u>Road Section 1. Delta Costa Rica-Fátima</u>: The road has drainage structures and a gravel road surface in acceptable condition.

  -<u>Road Section 2. Fátima-Sarapiquí River Mouth</u>: The road has some unfinished drainage structures, and the road platform is stabilized with material taken from the river. The road surface should be improved.

  -<u>Road Section 3. Copalchí-Remolinito</u>: The road platform consists of dirt, there are some unfinished drainage structures and localized unstable cut and fill areas. No works have been done in a major sector of this road section, except for road layout and initial blaze trailing.

  -<u>Road Section 4. Remolinito-Cureña</u>: The road platform consists of dirt, there are no drainage structures, and at some points passage is blocked by unfinished and unstable cut and fills areas. One sector was also found with very sandy granular material that is being eroded by vehicle traffic, wind, and water.

  -<u>Road Section 5. Cureña-San Carlos River Mouth</u>: The road has drainage structures and a gravel surface in good condition.

  -<u>Road Section 6. San Carlos River Mouth-Infiernito River</u>: There is a lot of unfinished and unstable earthmoving, cuts and fills interrupting the Trail at different points along this road section.

  -<u>Road Section 7. Infiernito River-Quarry in Tiricias</u>: The road has a gravel surface in good condition. Some points do not have any drainage structures.

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-Road Section 8. Quarry in Tiricias-San Isidro: This road section runs parallel to the San Juan River and has a gravel road surface in good condition. In turn, the portion running parallel to the land border crosses a forest area on a rolling terrain, is a dirt road, and there is a large number of sites with no drainage structures, which have been provisionally replaced by logs.

-Road Section 9. San Isidro-Pocosol River:The road has a gravel surface in good condition, and one sector is still a dirt road with unfinished drainage structures.

- The absence of bridges on Sarapiquí, San Carlos, and Pocosol rivers –a total length of at least 400 meters to be built– disrupts Border Trail continuity at three points, thus limiting functionality.
- The road exhibits an irregular layout in some sectors with moderate to high slopes, in addition to unfinished and unstable cuts and fills that could collapse due to rain action. These cuts and fills were apparently made based on machine operator judgment and experience without any topographic and geotechnical information.
- A disproportionate embankment –over 30 meters wide– compared to road surface (six meters wide as an average) was built along most the trail. This involves higher costs in earthmoving –cuts and fill– and drainage construction.
- Throughout the Trail there are large drainage shortfalls that very likely will cut off the road at many places during the rainy season. Some of these shortfalls are as follows:

  - Nonexistent culvert crossings, which have been provisionally replaced by logs in some cases.
  - Use of non-conventional drainage structures –containers– that are deformed and under risk of collapsing.
  - Culvert crossings with very high fills and absent headwalls. In some cases these culverts are deformed and under risk of collapsing.

- Different types of granular material have been used in the Trail to shape and stabilize the road surface. Some come from rivers located far from the project, while others come from overburden stripping or quarries near the road.

  Apparently, there was no control over properties and quality of granular materials used, given some undesirable situations were seen, such as:

  - River material with a lot of oversize suitable for stabilizing the platform, although inadequate to be used for road surface, was found in some sectors.
  - Very sandy materials unsuitable for both road platform and surface, on account of their being easily carried off by traffic, wind, and water, were found in other sectors.
  - These river materials were mostly hauled over long distances entailing a major cost. At any rate, using materials with undesirable properties is unacceptable.
  - In the case of materials coming from overburden or quarries, some were found to be too degraded with an excess amount of fines ("talc"), which could lead to erosion and deformation problems, particularly if laid in thin layers.
- The project was implemented with several active work fronts much likely operating without a proper control, as evidenced by many sites that were worked on and then subsequently abandoned, in view of adverse conditions requiring an engineering solution.
- It is highly likely that no uniform technical criteria were set in project implementation since much variability is observed in works done in the different road sections, in both standards used and work quality.
- Evidently, the project failed to follow basic engineering practices during planning and implementation, such as: land survey for road layout; critical point geotechnical assessment; drainage structure location, design, and construction; defining suitable and uniform technical standards; inspection deficiency.

- In its current condition the Border Trail has a high risk of collapsing during the rainy season as a result of nonexistent drainage structures and instability of a large number of cuts and fills. If this comes to happen it would entail a substantial loss of investments made so far, since it would involve rebuilding many road sections.
- Current Border Trail condition limits its social and economic impact because its functionality is not in line with investment and efforts made by the country in building it.
- Leaving the Border Trail in full operating condition immediately requires a major additional investment of resources to build missing drainage structures, complete and stabilize many cut and fill sectors, and particularly build bridges over Sarapiquí, San Carlos, and Pocosol rivers.
- Current road layout indicates it was done without any basic geometric design that would have enabled a more efficient use of invested resources. While it is true that work done so far is consistent with a trail, given investment size, they should have considered the need for carrying out a simple georeferenced-based land survery using modern design software and lasting only a few weeks to produce a more engineering-oriented final project layout.

7.2 Recommendations

- Reviewing current trail layout by means of an adequate land survey and geometric design
- Completing the construction of adequate drainage structures in trail sectors having a stable gravel platform as a high priority, in order to protect road investment and functionality.
- Building drainages in the other road sectors consisting of a dirt trail. All these drainage works should be designed according to hydrological requirements in the area and existing waterbody hydraulic characteristics.

- Assessing the likelihood of building bridges conforming to Ministry of Public Works and Transportation (MOPT)-type drawings over some rivers and brooks along the trail that have provisional stream crossings.
- Performing assessments and geotechnical studies on unfinished and unstable cut and fill areas, trying not to disturb them any further because of the high costs potentially involved in stabilizing them.
- Strengthening project management and inspection focusing on work fronts in shorter road sections to achieve a more controlled and efficient project progress.
- Assessing the use of geotextiles or other techniques to stabilize road platform, in order to reduce the use of granular materials that are very costly on account of the long hauling distances to some project areas.
- Establishing an aggregate selection and classification process at extraction sources to insure all materials used in the project are suitable and will have a good performance.
- Expanding the use of erosion stabilization and control practices to the different project sectors requiring them. Assessing the use of vegetative methods that could be easily applied in several sectors.
- Developing a technical profile of works pending implementation to leave the border trail in full operating conditions, in order to guide political, technical, and financial decisions required to complete it.
- Defining mechanisms and putting resources available to implement a maintenance and emergency attention program in the border trail.
- As soon as possible, allocating engineering resources to the project in line with the investment made and the far-reaching nature of this work in the country.

Annex 4

Federated Association of Engineers and Architects of Costa Rica, "Report on Inspection of the on the Border Road, Northern Area Parallel to the San Juan River CFIA Report".

8 June 2012

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

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

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

PRELIMINARY REPORT

1. Background

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

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

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

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

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

2. Objective and scope

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

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

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

3. GENERAL ASPECTS

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

4. RESULTS OF THE INSPECTION

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

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

4.1.1 Arteries that access route 1856:

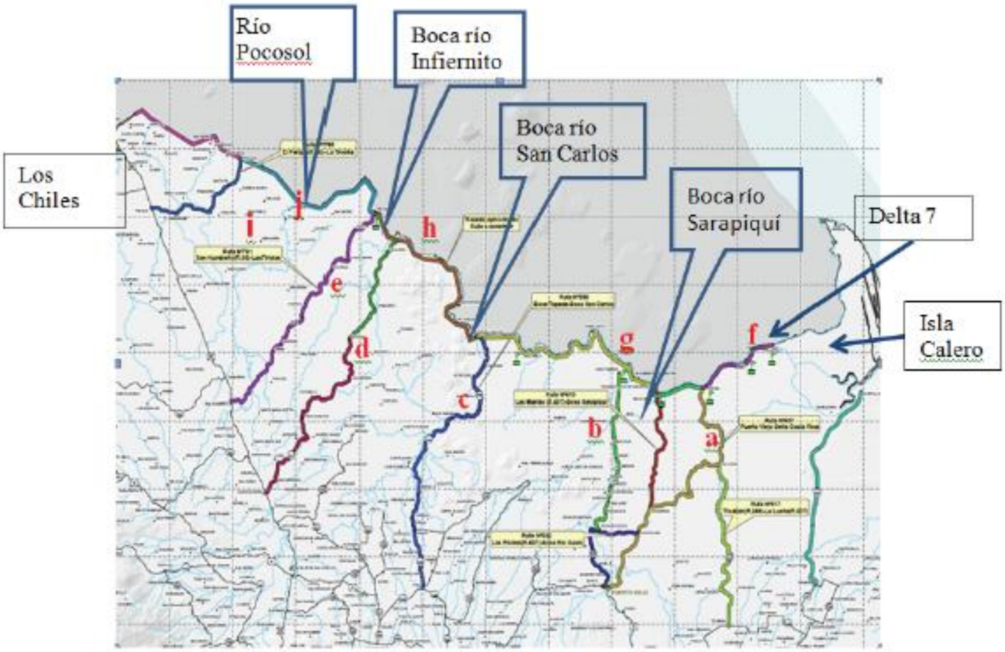
a) Puerto Viejo – Fátima route
b) Boca Río Sucio – Caño Tambor hillside route
c) Boca Tapada – Boca San Carlos route
d) Buenos Aires – Moravia – Crucitas
e) San Humberto – Las Tiricias route
i) Parque – La Trocha, Route 760

4.1.2 Route 1856:

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

Diagram No. 1

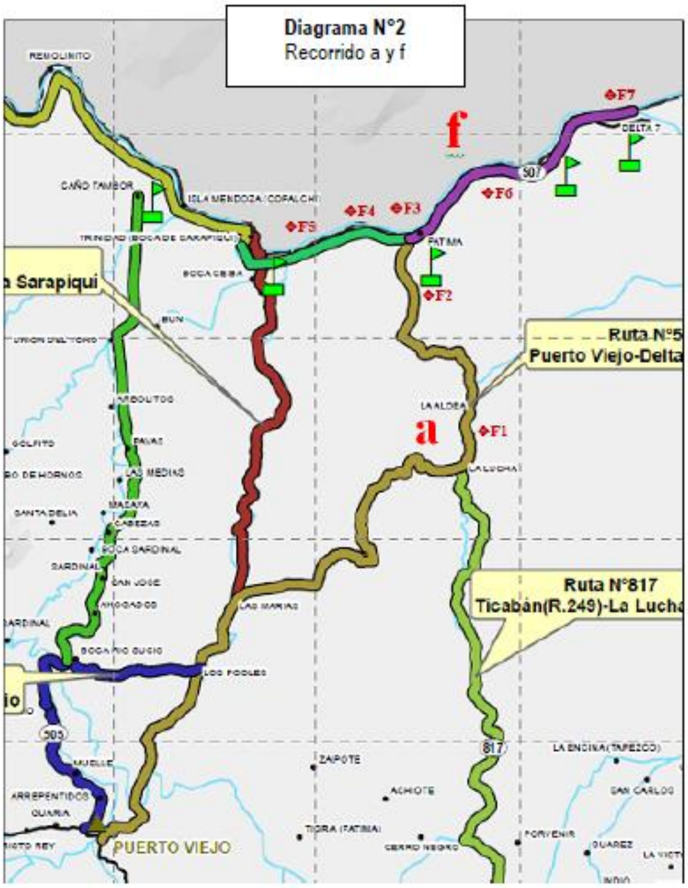
Juan Rafael Mora Route 1856 and arteries that access it:



Km 0, Delta 7, Costa Rica

Diagram No. 2

Visit (a) and (f)



a) Puerto Viejo – Fátima route

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


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

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

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

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

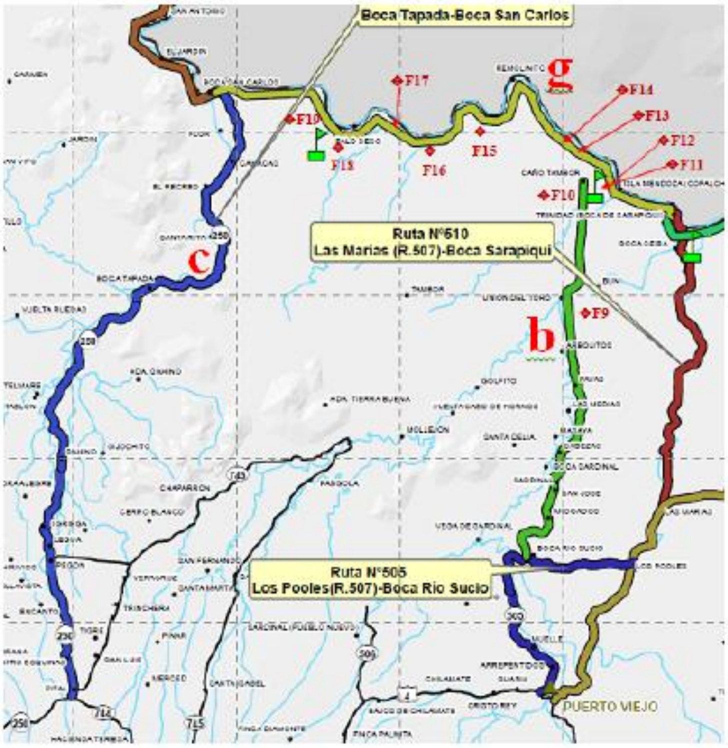
F3. A PVC drainage is obstructed by movement of *finos* of the base layer.

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

F5. Bridge with a base built from wooden logs.

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

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



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

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

F9. The route is generally in good condition.

F10. Machinery and stored supplies were observed.

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

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

F11. Paths with compacted earth.

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

F13. Different bridges on wooden pillars can be observed.

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

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

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

a b c d

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

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

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

Piling of material

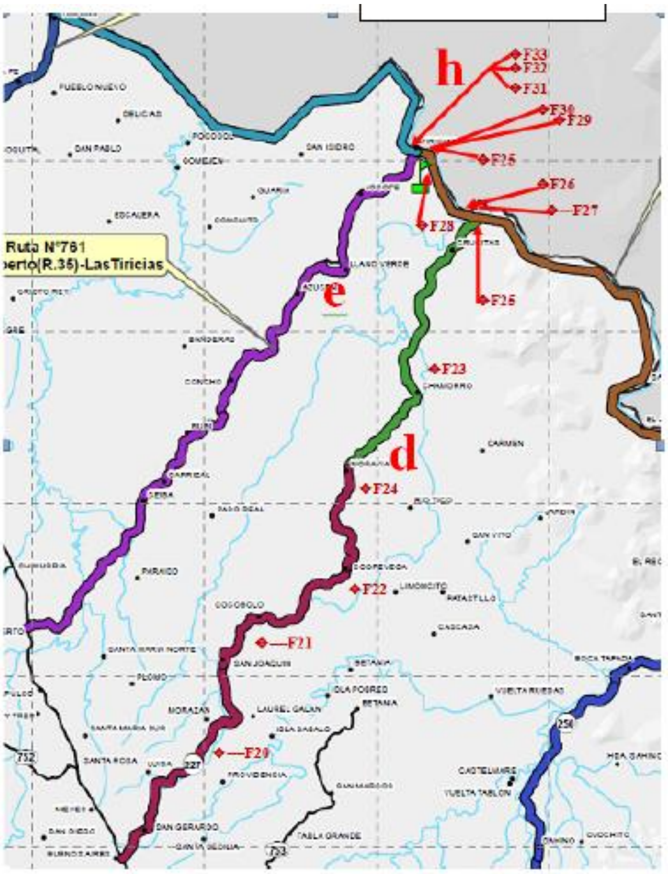
Trench

Río San Juan

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

The edge of the road

Diagram No. 4, Visit d, e and h



d) Buenos Aires – Moravia – Crucitas

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

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


F20. Lack of maintenance to the drainage canals.

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


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

F23. Possible impact to wetlands.

F24. Areas with cracks and holes and no drainage.

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

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

h) The 15 kilometers in the area near Tiricias.

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

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

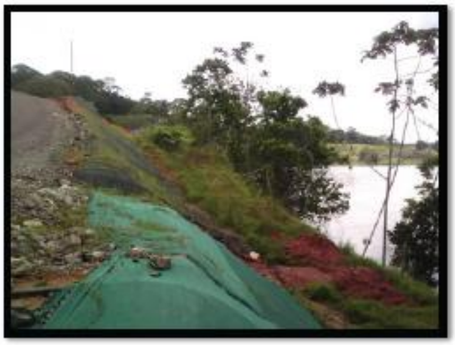
F27. There are huge slopes with high peaks in this area and no protection whatsoever.

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


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

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


F31. Deforestation in wetlands area.

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

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

F35. Materials and machinery depot.

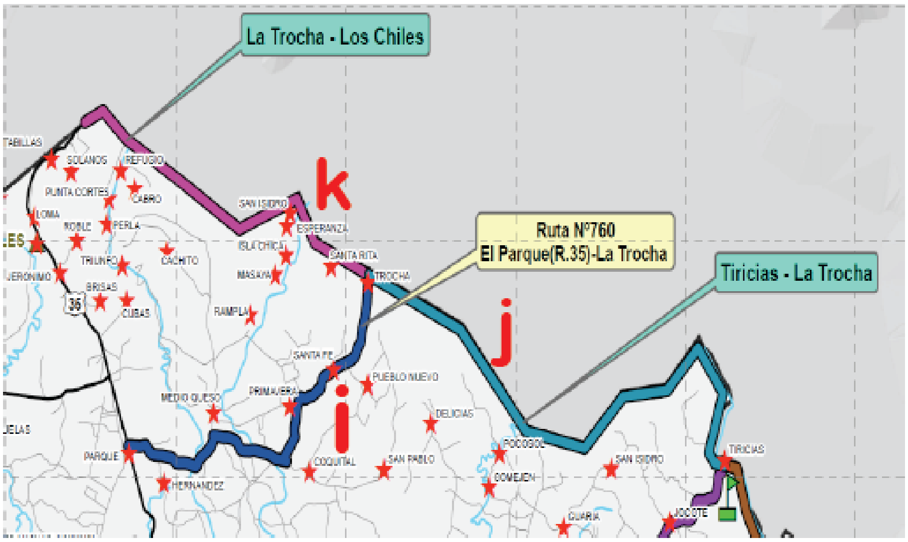
F34. Stagnant water with no drainage whatsoever.

F36. Work in this area is incomplete.

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

Diagram No. 5

Visits I, j and k



i) Route 760 Parque – La Trocha

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

F38. Dirt road from Route 760 El Parque.

j) Approximately five kilometers of Trocha toward Los Chiles

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


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

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


F41. Circular pipe serving as outlet for river water.

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

F43. Stagnant water and deforestation.

k) Approximately 23 kilometers of road toward Tiricias.

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

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

F44. View of a dirt stretch.

F45. View of a gravel stretch.

F46. Circular pipes serving as outlets for river water.

F47. Trailer container used as a bridge.


F48. Bridge and waterway with wooden logs.

F49. Bridge being used for heavy machinery.


F50. Clearing of slope approximately six meters high.

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


F52. Dirt drainage ditch serving as water outlet.

F53. Stagnant water present in some parts.

5. CONCLUSIONS

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

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

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

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

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

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

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

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

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

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

6. RECOMMENDATIONS

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

6.2 Short-term interventions

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

6.3 Midrange second phase work

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

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

Inspectors,

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

And Architects

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

Annex 5

Treaty of Limits between Nicaragua and Costa Rica.

15 April 1858.

ARGUMENT

ON THE QUESTION OF THE VALIDITY OF THE TREATY OF LIMITS BETWEEN COSTA RICA AND NICARAGUA

AND

OTHER SUPPLEMENTARY POINTS CONNECTED WITH IT,

SUBMITTED TO THE

Arbitration of the President of the United States of America,

FILED ON BEHALF OF THE GOVERNMENT OF COSTA RICA

BY

PEDRO PÉREZ ZELEDÓN,

ITS ENVOY EXTRAORDINARY AND MINISTER PLENIPOTENTIARY
IN THE UNITED STATES.

(TRANSLATED INTO ENGLISH BY J. L. RODRIGUEZ.)

WASHINGTON:
GIBSON BROS., PRINTERS AND BOOKBINDERS.
1887.

DOCUMENTS.

No. 1.

Treaty of Limits between Costa Rica and Nicaragua, concluded April 15th, 1858.

We, Máximo Jerez, Minister Plenipotentiary of the Government of the Republic of Nicaragua, and José Maria Cañas, Minister Plenipotentiary of the Government of the Republic of Costa Rica, having been entrusted by our respective Governments with the mission of adjusting a treaty of limits between the two Republics, which should put an end to all the differences which have obstructed the perfect understanding and harmony that must prevail among them for their safety and prosperity, and having exchanged our respective powers, which were examined by Hon. Señor Don Pedro R. Negrete, Minister Plenipotentiary of the Government of the Republic of Salvador, exercising the functions of fraternal mediator in these negotiations, who found them to be good and in due form, as we on our part also found good and in due form the powers exhibited by the said Minister, after having discussed with the necessary deliberation all the points in question, with the assistance of the representative of Salvador who was present, have agreed to and adjusted the following Treaty of Limits between Nicaragua and Costa Rica.

Article I.

The Republic of Nicaragua and the Republic of Costa Rica declare in the most solemn and express terms that if for one moment they were about to enter into a struggle for reason of limits and for others which each one of the high contracting parties considered to be legal and a matter of honor, now after having given each other repeated proofs of good understanding, peaceful principles, and true fraternity, they are willing to bind themselves, as they formally do, to secure that the peace happily re-established should be each day more and more affirmed between the Government and the people of both nations, not only for the good and advantage of Nicaragua and Costa Rica, but for the happiness and prosperity which, to a certain extent, our sisters, the other Central American Republics, will derive from it.

ARTICLE II.

The dividing line between the two Republics, starting from the Northern Sea, shall begin at the end of Punta de Castilla, at the mouth of the San Juan de Nicaragua river, and shall run along the right bank of the said river up to a point three English miles distant from Castillo Viejo, said distance to be measured between the exterior works of said castle and the above-named point. From here, and taking the said works as centre, a curve shall be drawn along said works, keeping at the distance of three English miles from them, in its whole length, until reaching another point, which shall be at the distance of two miles from the bank of the river on the other side of the castle. From here the line shall continue in the direction of the Sapoá river, which empties into the Lake of Nicaragua, and it shall follow its course, keeping always at the distance of two miles from the right bank of the San Juan river all along its windings, up to reaching its origin in the lake; and from there along the right shore of the said lake until reaching the Sapoá river, where the line parallel to the bank and shore will terminate. From the point in which the said line shall coincide with the Sapoá river—a point which, according to the above description, must be two miles distant from the lake—an astronomic straight line shall be drawn to the central point of the Salinas Bay in the Southern Sea, where the line marking the boundary between the two contracting Republics shall end.

Article III.

Such surveys as may be required to locate this boundary, whether in whole or in part, shall be made by Commissioners appointed by the two Governments; and the two Governments shall agree also as to the time when the said survey shall be made. Said Commissioners shall have the power to somewhat deviate from the curve around the castle, from the line parallel to the banks of the river and the lake, or from the astronomic straight line between Sapoá and Salinas, if they find that natural land-marks can be substituted with advantage.

Article IV.

The Bay of San Juan del Norte, as well as the Salinas Bay, shall be common to both Republics, and, therefore, both the advantages of their use and the obligation to contribute to their defence shall also be common. Costa Rica shall be bound, as far as the portion of the banks of the San Juan river which correspond to it is concerned, to contribute to its custody in the same way as the two Republics shall contribute to the defence of the river in case of external aggression; and this they shall do with all the efficiency within their reach.

Article V.

As long as Nicaragua does not recover the full possession of all her rights in the port of San Juan del Norte, the use and possession of Punta de Castilla shall be common and equal both for Nicaragua and Costa Rica; and in the meantime, and as long as this community lasts, the boundary shall be the whole course of the Colorado river. It is furthermore stipulated that, as long as the said port of San Juan del Norte remains a *free* port, Costa Rica shall not charge Nicaragua any custom duties at Punta de Castilla.

Article VI.

The Republic of Nicaragua shall have exclusively the dominion and sovereign jurisdiction over the waters of the San Juan river from its origin in the Lake to its mouth in the Atlantic; but the Republic of Costa Rica shall have the perpetual right of free navigation on the said waters, between the said mouth and the point, three English miles distant from Castillo Viejo, said navigation being for the purposes of commerce either with Nicaragua or with the interior of Costa Rica, through the San Carlos river, the Sarapiquí, or any other way proceeding from the portion of the bank of the San Juan river, which is hereby declared to belong to Costa Rica. The vessels of both countries shall have the power to land indiscriminately on either side of the river, at the portion thereof where the navigation is common; and no charges of any kind, or duties, shall be collected unless when levied by mutual consent of both Governments.

Article VII.

It is agreed that the territorial division made by this treaty cannot be understood as impairing in any way the obligations contracted whether in public treaties or in contracts of canalization or public transit by the Government of Nicaragua previous to the conclusion of the present treaty; on the contrary, it is understood that Costa Rica assumes those obligations, as far as the portion which corresponds to its territory is concerned, without injury to the eminent domain and sovereign right which it has over the same.

Article VIII.

If the contracts of canalization or transit entered into by the Government of Nicaragua previous to its being informed of the conclusion of this treaty should happen to be invalidated for any reason whatever, Nicaragua binds herself not to enter into any other arrangement for the aforesaid purposes without first hearing the opinion of the Government of Costa Rica as to the disadvantages which the transaction might occasion the two countries; provided that the said opinion is rendered within the period of 30 days after the receipt of the communication asking for it, if Nicaragua should have said that the decision was urgent; and, if the transaction does not injure the natural rights of Costa Rica, the vote asked for shall be only advisory.

Article IX.

Under no circumstances, and even in case that the Republics of Costa Rica and Nicaragua should unhappily find themselves in a state of war, neither of them shall be allowed to commit any act of hostility against the other, whether in the port of San Juan del Norte, or in the San Juan river, or the Lake of Nicaragua.

Article X.

The stipulation of the foregoing article being essentially important for the proper custody of both the port and the river against foreign aggression, which would affect the general interests of the country, the strict performance thereof is left under the special guarantee which, in the name of the mediator Government, its Minister Plenipotentiary herein present is ready to give, and does hereby give, in use of the faculties vested in him for that purpose by his Government.

Article XI.

In testimony of the good and cordial understanding which is established between the Republics of Nicaragua and Costa Rica, they mutually give up all claims against each other, on whatever ground they may be founded, up to the date of the present treaty; and in the same way the two contracting parties do hereby waive all claims for indemnification of damages which they might consider themselves entitled to present against each other.

ARTICLE XII.

This treaty shall be ratified, and the ratifications thereof shall be exchanged, at Santiago de Managua within forty days after it is signed.

In testimony whereof we have hereunto subscribed our names to the present instrument, executed in triplicate, together with the Hon. Minister of Salvador, and under the countersign of the respective secretaries of Legation, at the city of San José, in Costa Rica, on the 15th day of April, in the year of our Lord 1858.

MAXIMO JEREZ.
JOSÉ M. CAÑAS.
PEDRO RÓMULO NEGRETE.
MANUEL RIVAS,
Secretary of the Legation of Nicaragua.
SALVADOR GONZALEZ,
Secretary of the Legation of Costa Rica.
FLORENTINO SOUZA,
Secretary of the Legation of Salvador.

ADDITIONAL ACT.

The undersigned, Ministers of Nicaragua and Costa Rica, wishing to give public testimony of their high esteem and of their feelings of gratitude towards the Republic of Salvador, and the worthy representative of the same, Col. Don Pedro R. Negrete, have agreed that the treaty of territorial limits be accompanied with the following declaration, namely:

"Whereas, the Government of Salvador has given to the Governments of Costa Rica and Nicaragua the most authentic testimony of its noble feelings, and of its high appreciation of the value and necessity of cultivating fraternal sympathy

Annex 6

(1) 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 (Cleveland Award), reprinted United Nations, Report of International Arbitral Awards, Vol. XXVIII (2006), pp.207-211 Washington, D.C.,

22 March 1888.

(2) First Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.215-221, San Juan del Norte,

30 September 1897.

(3) Second Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.223-225, San Juan del Norte,

20 December 1897.

(4) Third Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.227-230, San Juan del Norte,

22 March 1898.

(5) Fourth Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.231-235, Greytown,

26 July 1899.

(1) 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 (Cleveland Award), reprinted United Nations, Report of International Arbitral Awards, Vol. XXVIII (2006), pp.207-211 Washington, D.C.,

22 March 1888.

REPORTS OF INTERNATIONAL ARBITRAL AWARDS

RECUEIL DES SENTENCES ARBITRALES

Award in regard to the validity of the Treaty of Limits between Costa Rica and Nicaragua of 15 July 1858

Decisions of 22 March 1888
30 September 1897
20 December 1897
22 March 1898
26 July 1899

VOLUME XXVIII pp. 189-236

NATIONS UNIES - UNITED NATIONS

to do so. It had a perfect right to waive this limitation of time. Either party to a Treaty may extend the time of the other, either by express agreement or by acts indicating acquiescence. Nicaragua cannot be permitted to say, as she does in effect say in this branch of her argument — "it is true that this Treaty was approved unreservedly by both the executive and legislative branches of the Government; but such approval is worthless, as it was expressed not forty but forty-three days after the signature of the Treaty."

The *fact* of approval being established, the *time* of approval is immaterial, provided the other party by its acquiescence has seen fit to waive delay.

I conclude therefore that the *third* ground of objection stated by Nicaragua is untenable.

And having examined in detail the three reasons urged by Nicaragua for holding the Treaty invalid, and finding all these reasons untenable, I conclude that the Arbitrator should decide in favor of the validity of this Treaty.

The Award

Grover Cleveland, President of the United States, to whom it shall concern, Greeting:

The functions of Arbitrator having been conferred upon the President of the United States by virtue of a Treaty signed at the City of Guatemala on the 24th day of December one thousand eight hundred and eighty-six, between the Republics of Costa Rica and Nicaragua, whereby it was agreed that the question pending between the contracting Governments in regard to the validity of their Treaty of Limits of the 15th day of April one thousand eight hundred and fifty-eight, should be submitted to the arbitration of the President of the United States of America; that if the Arbitrator's award should determine that the Treaty was valid, the same award should also declare whether Costa Rica has the right of navigation of the River San Juan with vessels of war or of the revenue service; and that in the same manner the Arbitrator should decide, in case of the validity of the Treaty, upon all the other points of doubtful interpretation which either of the parties might find in the Treaty and should communicate to the other party within thirty days after the exchange of the ratifications of the said Treaty of the 24th day of December one thousand eight hundred and eighty six;

And the Republic of Nicaragua having duly communicated to the Republic of Costa Rica eleven points of doubtful interpretation found in the said Treaty of Limits of the 15th day of April one thousand eight hundred and fifty-eight; and the Republic of Costa Rica having failed to communicate to the Republic of Nicaragua any points of doubtful interpretation found in the said last-mentioned Treaty;

And both parties having duly presented their allegations and documents to the Arbitrator, and having thereafter duly presented their respective answers to the allegations of the other party as provided in the Treaty of the 24th day of December one thousand eight hundred and eighty-six;

And the Arbitrator pursuant to the fifth clause of said last-named Treaty having delegated his powers to the Honorable George L. Rives, Assistant Secretary of State, who, after examining and considering the said allegations, documents and answers, has made his report in writing thereon to the Arbitrator;

Now therefore I, Grover Cleveland, President of the United States of America, do hereby make the following decision and award:

First. The above-mentioned Treaty of Limits signed on the 15th day of April one thousand eight hundred and fifty-eight, is valid.

Second. The Republic of Costa Rica under said Treaty and the stipulations contained in the sixth article thereof, has not the right of navigation of the River San Juan with vessels of war; but she may navigate said river with such vessels of the Revenue Service as may be related to and connected with her enjoyment of the 'purposes of commerce' accorded to her in said article, or as may be necessary to the protection of said enjoyment.

Third. With respect to the points of doubtful interpretation communicated as aforesaid by the Republic of Nicaragua, I decide as follows:

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

2. The central point of the Salinas Bay is to be fixed by drawing a straight line across the mouth of the Bay and determining mathematically the centre of the closed geometrical figure formed by such straight line and the shore of the Bay at low-water mark.

3. By the central point of Salinas Bay is to be understood the centre of the geometrical figure formed as above stated. The limit of the Bay towards the ocean is a straight line drawn from the extremity of Punta Arranca Barba, nearly true South to the Westernmost portion of the land about Punta Sacate.

4. The Republic of Costa Rica is not bound to concur with the Republic of Nicaragua in the expenses necessary to prevent the Bay of San Juan del Norte from being obstructed; to keep the navigation of the River or Port free and unembarrassed, or to improve it for the common benefit.

5. The Republic of Costa Rica is not bound to contribute any proportion of the expenses that may be incurred by the Republic of Nicaragua for any of the purposes above mentioned.

6. The Republic of Costa Rica cannot prevent the Republic of Nicaragua from executing at her own expense and within her own territory such works of improvement, *provided* such works of improvement do not result in the occupation or flooding or damage of Costa Rica territory, or in the destruction or serious impairment of the navigation of the said River or any of its branches at any point where Costa Rica is entitled to navigate the same. The Republic of Costa Rica has the right to demand indemnification for any places belonging to her on the right bank of the River San Juan which may be occupied without her consent, and for any lands on the same bank which may be flooded or damaged in any other way in consequence of works of improvement.

7. The branch of the River San Juan known as the Colorado River must not be considered as the boundary between the Republics of Costa Rica and Nicaragua in any part of its course.

8. The right of the Republic of Costa Rica to the navigation of the River San Juan with men-of-war or revenue cutters is determined and defined in the Second Article of this award.

9. The Republic of Costa Rica can deny to the Republic of Nicaragua the right of deviating the waters of the River San Juan in case such deviation will result in the destruction or serious impairment of the navigation of the said River or any of its branches at any point where Costa Rica is entitled to navigate the same.

10. The Republic of Nicaragua remains bound not to make any grants for canal purposes across her territory without first asking the opinion of the Republic of Costa Rica, as provided in Article VIII of the Treaty of Limits of the 15th day of April one thousand eight hundred and fifty-eight. The natural rights of the Republic of Costa Rica alluded to in the said stipulation are the rights which, in view of the boundaries fixed by the said Treaty of Limits, she possesses in the soil thereby recognized as belonging exclusively to her; the rights which she possesses in the harbors of San Juan del Norte and Salinas Bay; and the rights which she possesses in so much of the River San Juan as lies more than three English miles below Castillo Viejo, measuring from the exterior fortifications of the said castle as the same existed in the year 1858; and perhaps other rights not here particularly specified. These rights are to be deemed injured in any case where the territory belonging to the Republic of Costa Rica is occupied or flooded; where there is an encroachment upon either of the said harbors injurious to Costa Rica; or where there is such an obstruction or deviation of the River San Juan as to destroy or seriously impair the navigation of the said River or any of its branches at any point where Costa Rica is entitled to navigate the same.

11. The Treaty of Limits of the 15th day of April one thousand eight hundred and fifty-eight does not give to the Republic of Costa Rica the right to be a party to grants which Nicaragua may make for inter-oceanic canals; though in cases where the construction of the canal will involve an injury to

the natural rights of Costa Rica, her opinion or advice, as mentioned in Article VIII of the Treaty, should be more than "advisory" or "consultative." It would seem in such cases that her consent is necessary, and that she may thereupon demand compensation for the concessions she is asked to make; but she is not entitled as a right to share in the profits that the Republic of Nicaragua may reserve for herself as a compensation for such favors and privileges as she, in her turn, may concede.

In testimony whereof, I have hereunto set my hand and have caused the Seal of the United States to be hereunto affixed.

[SEAL.] Done in duplicate at the City of Washington, on the twenty-second day of March, in the year one thousand eight hundred and eighty-eight, and of the Independence of the United States the one hundred and twelfth.

GROVER CLEVELAND.

By the President:
T. F. BAYARD,
Secretary of State.

Convention on border demarcation concluded between the Republic of Costa Rica and the Republic of Nicaragua signed at El Salvador on 27 March 1896*

The Presidents of Costa Rica and Nicaragua, having accepted the mediation of the Government of El Salvador in resolving the issue of demarcating the border between their two countries, have respectively designated as their extraordinary and plenipotentiary envoys, their Excellencies, Mr. Leonidas Pacheco and Mr. Manuel C. Matus. Following various meetings held in the presence of His Excellency, Mr. Jacinto Castellanos, Minister for Foreign Affairs of El Salvador, specially mandated representative of that Government, and their full powers having been found to be in good and proper form, the envoys have signed the following Convention. His Excellency, General Rafael A. Gutiérrez, President of the Republic of El Salvador, attended the signing ceremony to confer greater solemnity to the event.

ARTICLE I. — The Contracting Governments are bound to appoint a Commission, respectively, each composed of two engineers, or surveyors, for the purpose of duly defining and marking out the dividing line between the Republics of Costa Rica and Nicaragua according to the stipulations of the

* Original Spanish version, translation by the Secretariat of the United Nations.

Treaty of 15 April 1858 and the award of the President of the United States of America, Mr. Grover Cleveland.

ARTICLE II. — The Commissions established under article I shall include an engineer appointed by the President of the United States of America at the request of the two Parties, whose mandate shall include the following: to resolve any dispute between the Commissions of Costa Rica and Nicaragua arising from the operations. He shall have broad powers to decide whatever kind of differences may arise in the course of any operations and his ruling shall be final.

ARTICLE III. — Within three months of the signing of this Convention, which shall be duly ratified by the respective Congresses, the Representatives of both Contracting Governments in Washington shall jointly request the President of the United States of America to appoint the aforementioned engineer and confirm such appointment. Should such joint request fail to be made by the Representative in Washington of either Government or for any other reason within the stipulated time limit, upon expiration of such time limit, the Representatives of either Costa Rica or Nicaragua in Washington may separately make such request, which shall be as valid as if it had been made jointly by both Parties.

ARTICLE IV. — Upon confirmation of the appointment of the United States engineer and within three months of such appointment, the engineer shall proceed with demarcations of the border line and such operation shall be completed within 20 months of its starting date. The Commissions of the Contracting Parties shall meet in San Juan del Norte as agreed and shall begin their work at the extremity of the border starting from the Atlantic coast, as provided for by the aforementioned Treaty and award.

ARTICLE V. — The Contracting Parties agree that if, on the scheduled start date of the work, either one of the Commissions of the Republics of Costa Rica or Nicaragua failed for any reason to appear at the designated venue, the Commission of the other Republic present shall begin the work with the agreement of the United States Government engineer and such work as shall have been done shall be valid and definitive and shall not be open to appeal by the Republic that failed to send its Commissioners. The same shall apply should any or all the Commissioners of either Contracting Republic be absent once the work starts or refuse to carry out such operations as provided for in the award and Treaty referred to herein or as decided by the engineer appointed by the President of the United States.

ARTICLE VI. — The Contracting Parties agree that the deadline for the completion of the boundary marking is not mandatory so that any operations carried out upon the expiration thereof shall be valid either because such operations could not have been completed within the deadline or because the commissioners of Costa Rica and Nicaragua have agreed together with the United States Government engineer to temporarily suspended such operations

(2) First Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.215-221, San Juan del Norte,

30 September 1897.

REPORTS OF INTERNATIONAL ARBITRAL AWARDS

RECUEIL DES SENTENCES ARBITRALES

First award under the Convention between Costa Rica and Nicaragua of 8 April 1896 for the demarcation of the boundary between the two Republics

30 September 1897

VOLUME XXVIII pp. 215-222

FIRST AWARD OF THE ENGINEER-UMPIRE, UNDER THE CONVENTION BETWEEN COSTA RICA AND NICARAGUA OF 8 APRIL 1896 FOR THE DEMARCATION OF THE BOUNDARY BETWEEN THE TWO REPUBLICS, DECISION OF 30 SEPTEMBER 1897[*]

PREMIÈRE SENTENCE ARBITRALE RENDUE PAR LE SURARBITRE INGÉNIEUR, EN VERTU DE LA CONVENTION ENTRE LE COSTA RICA ET LE NICARAGUA DU 8 AVRIL 1896 POUR LA DÉMARCATION DE LA FRONTIÈRE ENTRE LES DEUX RÉPUBLIQUES, DÉCISION DU 30 SEPTEMBRE 1897[**]

Interpretation of treaty – treaty must be interpreted in the way in which it was mutually understood at the time by its makers – meaning understood from the language taken as a whole and not deduced from isolated words or sentences – the non use of some names may be as significant as the use of others – Treaty of limits of 15 April 1858.

Delimitation of boundary – a temporary connection between an island and mainland during the dry season may not change permanently the geographical character and political ownership of the island – the river being treated and regarded as an outlet of commerce in the Treaty; it has to be considered when it is navigable, with an average water level.

Interprétation des traités – un traité doit être interprété conformément à la conception mutuelle de ses auteurs au moment de son élaboration – le sens doit être dégagé du texte pris dans sa globalité et non déduit de termes ou de phrases isolés – le non emploi de certains noms propres peut être aussi significatif que l'emploi de certains autres.

Délimitation frontalière – une liaison temporaire pendant la saison sèche entre une île et le continent ne peut pas changer de façon permanente le caractère géographique et la possession politique de cette île – dans le traité, le fleuve étant désigné et envisagé comme une infrastructure commerciale, il doit être pris en compte lorsqu'il est navigable, c'est à dire avec un niveau d'eau moyen.

* * * * *

[*] Reprinted from John Basset Moore, *History and Digest of the International Arbitrations to Which the United States has been a Party*, vol. V, Washington 1898, Government Printing Office, p.5074.

[**] Reproduit de John Basset Moore, *History and Digest of the International Arbitrations to Which the United States has been a Party*, vol. V, Washington , 1898, Government Printing Office, p. 5074.

SAN JUAN DEL NORTE, NICARAGUA,
September 30, 1897.

To the Commissions of Limits of Costa Rica and Nicaragua.

GENTLEMEN: In pursuance of the duties assigned me by my commission as engineer-arbitrator to your two bodies, with the power to decide finally any points of difference that may arise in tracing and marking out the boundary line between the two republics, I have given careful study and consideration to all arguments, counter arguments, maps, and documents submitted to me in the matter of the proper location of the initial point of the said boundary line upon the Caribbean coast.

The conclusion at which I have arrived and the award I am about to make do not accord with the views of either commission. So, in deference to the very excellent and earnest arguments so faithfully and loyally urged by each commission for its respective side, I will indicate briefly my line of thought and the considerations which have seemed to me to be paramount in determining the question; and of these considerations the principal and the controlling one is that we are to interpret and give effect to the treaty of April 15, 1858, in the way *in which it was mutually understood at the time by its makers*.

Each commission has presented an elaborate and well-argued contention that the language of that treaty is consistent with its claim for a location of the initial point of the boundary line at a place which would give to its country great advantages. These points are over six miles apart, and are indicated on the map accompanying this award.

The Costa Rican claim is located on the left-hand shore or west headland of the harbor; the Nicaraguan on the east headland of the mouth of the Taura branch.

Without attempting to reply in detail to every argument advanced by either side in support of its respective claim, all will be met and sufficiently answered by showing that those who made the treaty mutually understood and had in view another point, to wit, the eastern headland at the mouth of the harbor.

It is the meaning of the men who framed the treaty which we are to seek, rather than some possible meaning which can be forced upon isolated words or sentences. And this meaning of the men seems to me abundantly plain and obvious.

This treaty was not made hastily or carelessly. Each state had born wrought up by years of fruitless negotiations to a state of readiness for war in defense of what it considered its rights, as is set forth in article 1. In fact, war had actually been declared by Nicaragua on November 25, 1857, when, through the mediation of the Republic of Salvador, a final effort to avert it was made, another convention was held, and this treaty resulted. Now, we may arrive at the mutual understanding finally reached by its framers by first seeking in the treaty as a whole for the general idea or scheme of compromise upon which they were able to agree. Next, we must see that this general idea of the treaty as a whole harmonizes fully with any description of the line given in detail, and the proper names of all the localities used, or *not used*, in connection therewith, for the *non use* of some names may be as significant as the use of others. Now, from the general consideration of the treaty as a whole the scheme of compromise stands out clear and simple.

Costa Rica was to have as a boundary line the right or southeast bank of the river, considered as an outlet for commerce, from a point 3 miles below Castillo to the sea.

Nicaragua was to have her prized “sumo imperio” of all the waters of this same outlet for commerce, also unbroken to the sea.

It is to be noted that this division implied also, of course, the ownership by Nicaragua of all islands in the river and of the left or northwest bank and headland.

This division brings the boundary line (supposing it to be traced downward along the right bank from the point near Castillo) across both the Colorado and the Taura branches.

It can not follow either of them, for neither is an outlet for commerce, as neither has a harbor at its mouth.

It must follow the remaining branch, the one called the Lower San Juan, through its harbor and into the sea.

The natural terminus of that line is the right-hand headland of the harbor mouth.

Next let us note the language of description used in the treaty, telling whence the line is to start and how it is to run, leaving out for the moment the proper name applied to the initial point. It is to start “at the mouth of the river San Juan de Nicaragua, and shall continue following the right bank of the said river to a point three English miles from Castillo Viejo”.

This language is evidently carefully considered and precise, and there is but one starting point possible for such a line, and that is at the right headland of the bay.

Lastly, we come to the proper name applied to the starting point, “the extremity of Punta de Castillo”. This name Punta de Castillo does not appear upon a single one of all the original maps of the bay of San Juan which have been presented by either side, and which seem to include all that were ever published before the treaty or since. This is a significant fact, and its meaning is obvious. Punta de Castillo must have been, and must have remained, a point of no importance, political or commercial, otherwise it could not possibly have so utterly escaped note or mention upon the maps. This agrees entirely with the characteristics of the mainland and the headland on the right of the bay. It remains until today obscure and unoccupied, except by the hut of a fisherman. But the identification of the locality is still further put beyond all question by the incidental mention, in another article of the treaty itself, of the name Punta de Castillo.

In Article V. Costa Rica agrees temporarily to permit Nicaragua to use Costa Rica's side of the harbor without payment of port dues, and the name Punta de Castillo is plainly applied to it. Thus we have, concurring, the general idea of compromise in the treaty as a whole, the literal description of the line in detail, and the verification of the name applied to the initial point by its incidental mention in another portion of the treaty, and by the concurrent testimony of every map maker of every nation, both before the treaty and since, in excluding this name from all other portions of the harbor. This might seem to be sufficient argument upon the subject, but it will present the whole situation in a still clearer light to give a brief explanation of the local geography and of one special peculiarity of this Bay of San Juan.

The great feature in the local geography of this bay, since our earliest accounts of it, has been the existence of an island in its outlet, called on some early maps the island of San Juan. It was an island of such importance as to have been mentioned in 1820 by two distinguished authors, quoted in the Costa Rican reply to Nicaragua's argument (page 12), and it is an island to-day, and so appears in the map accompanying this award. The peculiarity of this bay, to be noted, is that the river brings down very little water during the annual dry season. When that happens, particularly of late years, sand bars, dry at all ordinary tides, but submerged more or less and broken over by the waves at all high ones, are formed, frequently reaching the adjacent headlands, so that a man might cross dry-shod.

Now, the whole claim of Costa Rica is based upon the assumption that on April 15, 1858, the date of the treaty, a connection existed between the island and the eastern headland, and that this converted the island into mainland, and carried the initial point of the boundary over to the western extremity of the island. To this claim there are at least two replies, either one seeming to me conclusive.

First, the exact state of the bar on that day can not be definitely proven, which would seem to be necessary before drawing important conclusions.

However, as the date was near the end of the dry season, it is most probable that there was such a connection between the island and the eastern Costa Rican shore as has been described. But even if that be true, it would be unreasonable to suppose that such temporary connection could operate to change permanently the geographical character and political ownership of the island. The same principle, if allowed, would give to Costa Rica *every island in the river* to which sand bars from her shore had made out during that dry season. But throughout the treaty the river is treated and regarded as an outlet of commerce. This implies that it is to be considered as in average condition of water, in which condition alone it is navigable.

But the overwhelming consideration in the matter is that by the use of the name of Punta de Castillo for the starting point, instead of the name Punta Arenas, the makers of the treaty intended to designate the mainland on the east of the harbor. This has already been discussed, but no direct reply was made to the argument of Costa Rica quoting three authors as applying the name Punta de Castillo to the western extremity of the before-mentioned island, the point invariably called Point Arenas by all the naval and other officers, surveyors, and engineers who ever mapped it.

These authors are L. Montufar, a Guatemalan, in 1887; J. D. Gamez, a Nicaraguan, in 1889, and E. G. Squier, an American, date not given exactly, but subsequent to the treaty. Even of these, the last two merely used, once each, the name Punta de Castillo as an alternate for Punta Arenas. Against this array of authority we have, first, an innumerable number of other writers clearly far more entitled to confidence; second, the original makers of all the maps, as before pointed out, and third, the framers of the treaty itself, by their use of Punta de Castillo in Article V.

It must be borne in mind that for some years before the making of this treaty Punta Arenas had been by far the most important and conspicuous point in the bay. On it were located the wharves, workshops, offices, etc., of Vanderbilt's great transit company, conducting the through line from New York to San Francisco during the gold excitement of the early fifties. Here the ocean and river steamers met and exchanged passengers and cargo. This was the point sought to be controlled by Walker and the filibusters.

The village of San Juan cut no figure at all in comparison, and it would doubtless be easy to produce by hundreds references to this point as Punta Arenas by naval and diplomatic officers of all prominent nations, by prominent residents and officials, and by engineers and surveyors constantly investigating the canal problem, and all having a personal knowledge of the locality.

In view of all these circumstances, the jealousy with which each party to the treaty defined what it gave up and what it kept, the prominence and importance of the locality, the concurrence of all the original maps in the name, and its universal notoriety, I find it impossible to conceive that Nicaragua had conceded this extensive and important territory to Costa Rica, and that the latter's representative had failed to have the name Punta Arenas appear anywhere in the treaty. And for reasons so similar that it is unnecessary to repeat them, it is also impossible to conceive that Costa Rica should have accepted the Taura as her boundary and that Nicaragua's representative should have entirely failed to have the name Taura appear anywhere in the treaty.

Having then designated generally the mainland east of Harbor Head as the location of the initial point of the boundary line, it now becomes necessary to specify more minutely, in order that the said line may be exactly located and permanently marked. The exact location of the initial point is given in President Cleveland's award as the "extremity of Punta de Castillo, at the mouth of the San Juan de Nicaragua River, as they both existed on the 15th of April 1858".

A careful study of all available maps and comparisons between those made before the treaty and those of recent date made by boards of engineers and officers of the canal company, and one of to-day made by yourselves to accompany this award, makes very clear one fact: The exact spot which was the extremity of the headland of Punta de Castillo April 15, 1858, has long been swept over by the Caribbean Sea, and there is too little concurrence in the shore outline of the old maps to permit any certainty of statement of distance or exact direction to it from the present headland. It was somewhere to the northeastward, and probably between 600 and 1,600 feet distant, but it can not now be certainly located. Under these circumstances it best fulfills the demands of the treaty and of President Cleveland's award to adopt what is practically the headland of to-day, or the northwestern extremity of what seems to be the solid land, on the east side of Harbor Head Lagoon.

I have accordingly made personal inspection of this ground, and declare the initial line of the boundary to run as follows, to wit:

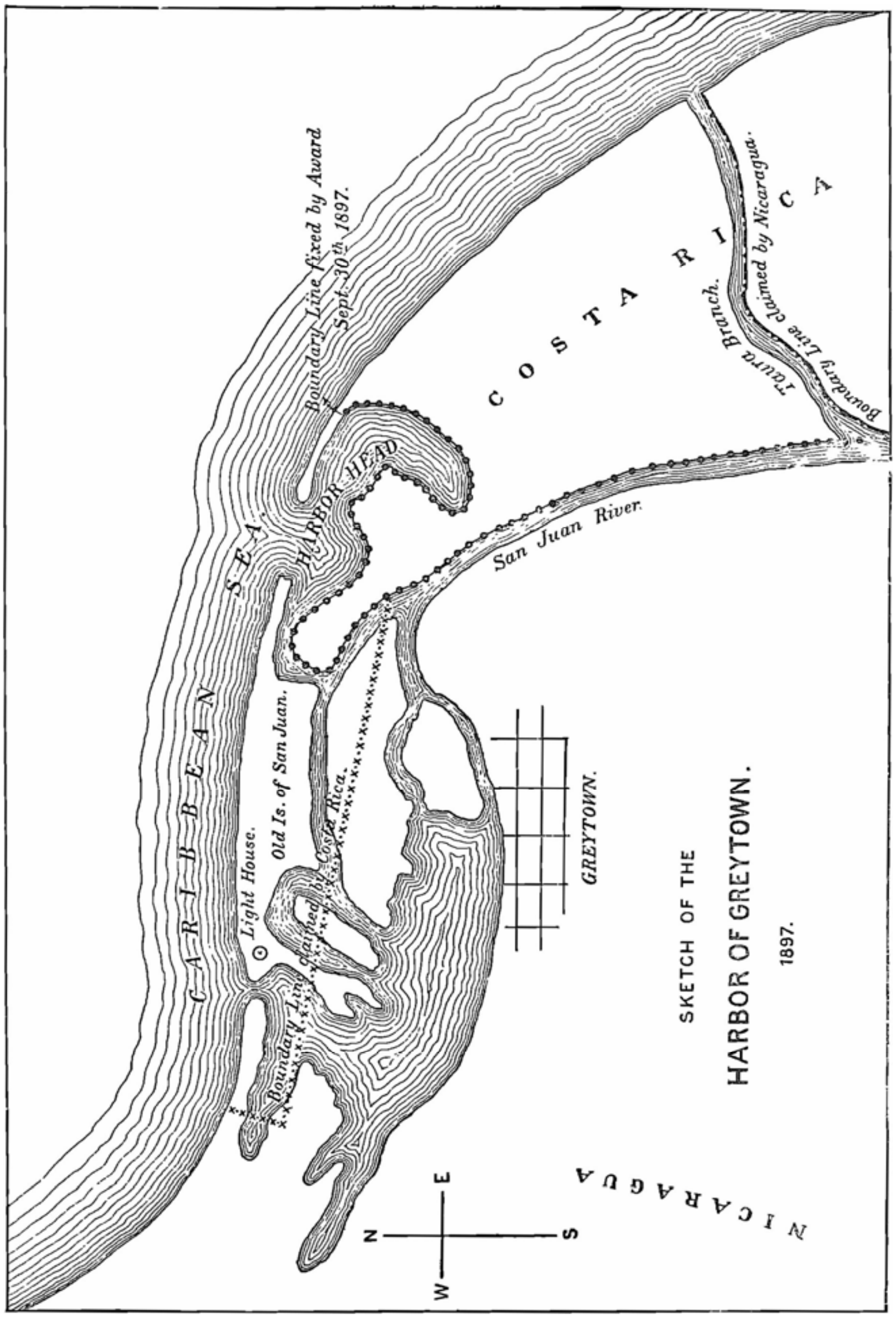
Its direction shall be due northeast and southwest, across the bank of sand, from the Caribbean Sea into the waters of Harbor Head Lagoon. It shall pass, at its nearest point, 300 feet on the northwest side from the small hut now standing in that vicinity. On reaching the waters of Harbor Head Lagoon the boundary line shall turn to the left, or southeastward, and shall follow the water's edge around the harbor until it reaches the river proper by the first channel met. Up this channel, and up the river proper, the line shall continue to ascend as directed in the treaty.

I am, gentlemen, very respectfully, your obedient servant,

E. P. ALEXANDER.

Annex 6

SKETCH OF THE HARBOR OF GREYTOWN – 1897



(3) Second Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.223-225, San Juan del Norte,

20 December 1897.

REPORTS OF INTERNATIONAL ARBITRAL AWARDS

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Second award under the Convention between Costa Rica and Nicaragua of 8 April 1896 for the demarcation of the boundary between the two Republics

20 December 1897

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SECOND AWARD OF THE ENGINEER-UMPIRE, UNDER THE CONVENTION BETWEEN COSTA RICA AND NICARAGUA OF 8 APRIL 1896 FOR THE DEMARCATION OF THE BOUNDARY BETWEEN THE TWO REPUBLICS, DECISION OF 20 DECEMBER 1897*

DEUXIÈME SENTENCE ARBITRALE RENDUE PAR LE SURARBITRE INGÉNIEUR, EN VERTU DE LA CONVENTION ENTRE LE COSTA RICA ET LE NICARAGUA DU 8 AVRIL 1896 POUR LA DÉMARCATION DE LA FRONTIÈRE ENTRE LES DEUX RÉPUBLIQUES, DÉCISION DU 20 DÉCEMBRE 1897**

Interpretation of treaty of delimitation – during demarcation process, accuracy of the measurement of the border-line is not as important as the finding natural landmarks, provided there is agreement between the two Parties – in case of disagreement, the view of the party favouring greater accuracy must prevail.

International boundary – natural changes of the banks of a river serving as an international boundary – determination of future changes made easier thanks to measurement and demarcation.

Interprétation d'un traité de délimitation – durant la procédure de démarcation, l'exactitude du métrage de la ligne frontière est moins importante que l'établissement de repères naturels, sous réserve de l'accord des deux Parties – en cas de désaccord, la position de la Partie en faveur de la plus grande exactitude doit prévaloir.

Frontière internationale – altérations naturelles des rives d'un fleuve servant de frontière internationale – détermination des modifications futures facilitée par le métrage et la démarcation.

* * * * *

Second award rendered, to San Juan del Norte, on December 20, 1897, in the boundary question between Nicaragua and Costa Rica.***

In pursuance once again of the duties assigned me by my commission as engineer-arbitrator to your two bodies, I have been called upon to decide on the matter submitted to me in the record dated the 7th of this month, as per the following paragraph of that record: "The Costa Rican Commission proposed

* Reprinted from H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne, 1902, p.532.

** Reproduit de H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne, 1902, p,532.

*** Original Spanish version, translated by the Secretariat of the United Nations.

that we proceed to the measurement of the line that ran from the starting point and continued along the shore of Harbor Head and thence along the shore around the harbor until it reaches the San Juan river proper by the first channel met and thence along the bank of the river to a point three miles below Castillo Viejo and that a map should be made of such line and that all of that should be set down in the daily record. The Nicaraguan Commission expressed the view that the measurement and mapping work on that portion of the line was pointless and worthless because, according to the Award by General E. P. Alexander, the left bank of the Harbor and of the river formed the boundary and that therefore the dividing line was subject to change and not permanent. Therefore, the map and any data obtained shall never correspond to the actual dividing line. To that end, the two Commissions have decided to hear the decision that the arbitrator would render within a week to their respective arguments submitted to him on that question."

The above-mentioned arguments of each party have been received and duly considered. It should be noted, for a clearer understanding of the question at hand, that the San Juan river runs through a flat and sandy delta in the lower portion of its course and that it is obviously possible that its banks will not only gradually expand or contract but that there will be wholesale changes in its channels. Such changes may occur fairly rapidly and suddenly and may not always be the result of unusual factors such as earthquakes or major storms. Examples abound of previous channels now abandoned and banks that are now changing as a result of gradual expansions or contractions.

Today's boundary line must necessarily be affected in future by all these gradual or sudden changes. But the impact in each case can only be determined by the circumstances of the case itself, on a case-by-case basis in accordance with such principles of international law as may be applicable.

The proposed measurement and demarcation of the boundary line will not have any effect on the application of those principles.

The fact that the line has been measured and demarcated will neither increase nor decrease any legal standing that it might have had it not been measured or demarcated.

The only effect obtained from measurement and demarcation is that the nature and extent of future changes may be easier to determine.

There is no denying the fact that there is a certain contingent advantage to being always able to locate the original line in future. But there may well be a difference of opinion as to how much time and expense needs to be spent in order to obtain such a contingent advantage. That is the difference now between the two Commissions.

Costa Rica wants to have that future capacity. Nicaragua feels that the contingent benefit is not worth the current expenditure.

In order to decide which one of these views should hold sway, I have to abide by the spirit and letter of the 1858 Treaty and to determine whether there is anything in either point of view that is applicable to the question. I find both things in article 3.

Article 2 describes the entire dividing line from the Caribbean Sea to the Pacific and article 3 continues thus: "measurements corresponding to this dividing line shall be taken in whole or in part by the Government commissioners, who shall agree on the time required for such measurements to be made. The commissioners shall be empowered to diverge slightly from the curve around El Castillo, from the line parallel to the banks of the river and lake, or from the straight astronomical line between Sapoá and Salinas, provided that they can agree upon this, in order to adopt natural landmarks."

The entire article is devoted to prescribing how the Commissioners should perform their task. It allows them to dispense with a few details because it says that the whole or part of the line may be measured and implies that accuracy is not as important as finding natural landmarks. But the condition expressly stipulated in the latter case and clearly understood also in the former is that the two Commissions must agree.

Otherwise, the line in its entirety must be measured, following all the practical steps described in article 2.

Clearly, therefore, the consequence of any disagreement on the question of whether the measurement is more or less accurate must be that the view of the party favouring greater accuracy should prevail.

I therefore announce my award as follows: the Commissioners shall immediately proceed to measuring the line from the starting point to a point three miles below El Castillo Viejo, as proposed by Costa Rica.

(4) Third Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.227-230, San Juan del Norte,

22 March 1898.

REPORTS OF INTERNATIONAL ARBITRAL AWARDS

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Third award under the Convention between Costa Rica and Nicaragua of 8 April 1896 for the demarcation of the boundary between the two Republics

22 March 1898

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THIRD AWARD OF THE ENGINEER-UMPIRE, UNDER THE CONVENTION BETWEEN COSTA RICA AND NICARAGUA OF 8 APRIL 1896 FOR THE DEMARCATION OF THE BOUNDARY BETWEEN THE TWO REPUBLICS, DECISION OF 22 MARCH 1898*

TROISIÈME SENTENCE ARBITRALE RENDUE PAR LE SURARBITRE INGÉNIEUR, EN VERTU DE LA CONVENTION ENTRE LE COSTA RICA ET LE NICARAGUA DU 8 AVRIL 1896 POUR LA DÉMARCATION DE LA FRONTIÈRE ENTRE LES DEUX RÉPUBLIQUES, DÉCISION DU 22 MARS 1898**

International boundary – necessity of stable boundaries – the bank of a river serving as boundary means the bank with the water at the ordinary stage – fluctuations in the water level do not alter the position of the boundary line – changes in the boundary can only occur when they affect the bed of the river.

Frontière internationale – nécessité de frontières stables – les berges d'un fleuve servant de frontière sont les berges correspondantes au niveau d'eau ordinaire – les fluctuations du niveau d'eau ne modifient pas la position de la ligne frontière – les modifications de lafrontière ne peuvent résulter que de changements dans le lit du fleuve.

* * * * *

Third award rendered, to San Juan del Norte, on 22 March 1898, in the boundary question between Nicaragua and Costa Rica.***

In indicating my reasons for the second award I referred briefly to the fact that, according to the well known rules of international law, the precise location of the dividing line on the right bank of the San Juan river that this Commission is now determining, may be altered in future by possible changes in the banks or channels of the river.

I am now being requesting by the current Nicaraguan Commissioner to complete this award with a more definitive statement as to the legal and permanent nature or stability of the border line, which is being demarcated on a daily basis.

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* Reprinted from H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne 1902, pp -533-535.

** Reproduit de H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne 1902, pp -533-535.

*** Original Spanish version, translated by the Secretariat of the United Nations.

What is effectively being sought is that I declare that this line will remain as the exact dividing line only as long as the waters of the river remain at their current level and that in future the dividing line may be determined on the basis of the water level at any particular moment.

The commissioner for Nicaragua submits the following in support of his argument:

> "Without engaging in a detailed discussion as to the meaning of a river bed or channel, which is the entire area of a territory through which a watercourse flows, I do wish to recall the doctrine of experts on public international law, which is summed up by Mr. Carlos Calvo in his work 'Le droit international théorique et pratique', [book 40, para. 295, page 385] thus: — 'Frontiers delimited by watercourses are subject to change when the beds of such watercourses undergo changes...'
>
> I note that present-day codes are consistent with that doctrine in providing that land that a river or lake submerges and uncovers periodically does not accrue to the adjoining land because it is the watercourse bed. According to article 728 of the Honduran Civil Code, land submerged or uncovered by a watercourse from time to time during periods of ebb and flow in water level does not accrue to adjoining land.
>
> It is therefore obvious that the mathematical line obtained and which continues to be obtained in the form to which reference is made, shall be used for illustrative purposes and as a possible reference point; however, that line is not the accurate measurement of the border line, which is and always shall be the right bank of the river as it may stand at any point in time."

The commissioner's argument, seen in the light of his mandate, as mentioned earlier, is born of a misconception which must be corrected.

While it is strictly speaking accurate that "the right bank of the river as it may stand at any point in time" shall always be the border line, the commissioner is obviously mistaken in believing that the legal location of the line defining the bank of a river will change in accordance with the river's water level.

Indeed, the word "bank" is often used loosely to refer to the first piece of dry land that emerges from the water; however the inappropriateness of such language becomes apparent if one considers instances where rivers overflow their banks for many miles or where their beds dry out completely. Such loose language cannot be entertained in interpreting a treaty on the demarcation of a border line. Borders are intended to maintain peace, thus avoiding disputes over jurisdiction. In order to achieve that goal, the border should be as stable as possible.

Obviously, such a state of affairs would be unacceptable to residents and property owners close to the borders of the two countries, if the line that determines the country to which they owe allegiance and must pay taxes, and whose laws govern all their affairs, was there one minute and not there the next, because such a border line would just generate conflicts instead of preventing them. The difficulties that would arise, for example, if certain lands and forests and their owners and residents or people employed in any capacity thereon, were required to be Costa Ricans in the dry season and Nicaraguans in the rainy season and alternatively of either nationality during the intermediate seasons are self evident. But such difficulties would definitely be inevitable if the border line between the two countries were subject to daily changes on the bank where land first rose above the water on the Costa Rican side, because in the rainy season, the river's waters submerge many miles of land in some localities.

It is for such reasons that writers on international law specifically maintain that temporary flooding does not give title to the submerged land. This is the real meaning of the language of the Honduran Code quoted by the Commissioner from Nicaragua. Transposed to the case at hand, it would read as follows: "Costa Rican land that Nicaraguan waters submerge or uncover from time to time, during periods of rise or fall in water level, does not accrue to adjoining (Nicaraguan) territory". As proof of that rule, I would like to cite examples of a host of cases in the United States of America where there are many ongoing law suits between states that have a river bank, and not the thread of a river channel, as one of their borders. I am personally familiar with one such case, where the left bank of the Savannah river is the boundary line between Georgia on the right bank and South Carolina on the left bank. During flooding, the river submerges miles of South Carolina territory, but this does not extend the power or jurisdiction of Georgia beyond the limits it had before with the water at ordinary stage. Thus, no advantage would be given to Georgia and it would be a great inconvenience to South Carolina. Nor do I believe that there is any example of such a mobile boundary in the world.

Clearly, therefore, wherever a treaty rules that the bank of a river shall be taken as a boundary, what is understood is not the temporary bank of land that emerges during exceptional high- or low-water stages, but the bank with the water at ordinary stage. And once defined by treaty, it will become permanent like the surface of the soil over which it flows. If the bank recedes the boundary line shrinks, if the bank expands towards the river, it moves forward.

The periodic rise and fall of the water level does not affect it. This is perfectly consistent with Carlos Calvo's rule quoted by the commissioner for Nicaragua that borders delimited by waterways are likely to change when changes occur in the beds of such waterways. In other words, it is the river bed that affects changes and not the water within, over or below its banks.

It would be useless to try to discuss all possible future changes in the bed or banks of the river and their impact just as it would be equally pointless to try to envisage future scenarios.

It is not this Commission's job to lay down rules for future contingencies but rather to define and mark out today's boundary line.

Let me sum up briefly and provide a clearer understanding of the entire question in accordance with the principles set out in my first award, to wit, that in the practical interpretation of the 1858 Treaty, the San Juan river must be considered a navigable river. I therefore rule that the exact dividing line between the jurisdictions of the two countries is the right bank of the river, with the water at ordinary stage and navigable by ships and general-purpose boats. At that stage, every portion of the waters of the river is under Nicaraguan jurisdiction. Every portion of land on the right bank is under Costa Rican jurisdiction. The measurement and delimitation work now being performed by the parties in the field every day defines points along this line at convenient intervals, but the border line between those points does not run in a straight line; as noted above, it runs along the banks of the river at the navigable stage in a curve with innumerable irregularities of little value which would require considerable expenditure to minutely demarcate.

Fluctuations in the water level will not alter the position of the boundary line, but changes in the banks or channels of the river will alter it, as may be determined by the rules of international law applicable on a case-by-case basis.

(5) Fourth Award of the Umpire EP Alexander in the boundary question between Costa Rica and Nicaragua, reprinted United Nations, Reports of International Arbitral Awards, Vol. XXVIII (2007) pp.231-235, Greytown,

26 July 1899.

REPORTS OF INTERNATIONAL ARBITRAL AWARDS

RECUEIL DES SENTENCES ARBITRALES

Fourth award under the Convention between Costa Rica and Nicaragua of 8 April 1896 for the demarcation of the boundary between the two Republics

26 July 1899

VOLUME XXVIII pp. 231-236

FOURTH AWARD OF THE ENGINEER-UMPIRE, UNDER THE CONVENTION BETWEEN COSTA RICA AND NICARAGUA OF 8 APRIL 1896 FOR THE DEMARCATION OF THE BOUNDARY BETWEEN THE TWO REPUBLICS, DECISION OF 26 JULY 1899*

QUATRIÈME SENTENCE ARBITRALE RENDUE PAR LE SURARBITRE INGÉNIEUR, EN VERTU DE LA CONVENTION ENTRE LE COSTA RICA ET LE NICARAGUA DU 8 AVRIL 1896 POUR LA DÉMARCATION DE LA FRONTIÈRE ENTRE LES DEUX RÉPUBLIQUES, DÉCISION DU 26 JUILLET 1899**

Interpretation of treaty – words must be taken in their first and simplest meanings, in their natural and obvious sense, according to their general use.

Lake boundary – bank of a lake – limit of water by dry land comprising some elements of permanency – natural, obvious and reasonable waterline preferable to technical one – water level for determining water boundary in the absence of an explicit level; general custom treats mean high water as the normal level and the assumed lake boundary, wherever wet and dry seasons prevail, in all ordinary topographical maps – exceptional situation of waterline used as starting point for boundary line rather than as boundary line – choice of the line of mean high water.

Interprétation des traités – les termes doivent être pris dans leur sens premier le plus simple, naturel et évident, conformément à leur emploi courant.

Frontière lacustre – rives d'un lac – limite de l'eau par un terrain sec comprenant des éléments de permanence – ligne de niveau d'eau naturelle, évidente et raisonnable, préférable à une ligne technique – ligne de niveau d'eau déterminant la frontière lacustre en l'absence de niveau explicite; pour les régions d'alternance de saisons sèches et humides, pratique générale de se référer dans les cartes topographiques ordinaires, à la ligne moyenne du niveau d'eau haut comme niveau normal et ligne de délimitation du lac – situation exceptionnelle où la ligne d'eau sert de point de départ de la ligne frontière au lieu d'être elle-même la ligne frontière – choix de la ligne moyenne du niveau d'eau haut.

* * * * *

Fourth Award made to Greytown, July 26, 1899, in the question of the limit between Costa Rica and Nicaragua.

As the arbitrator of whatever points of difference may arise between your two bodies in tracing and marking the boundary lines between the Republics you represent, I am called upon to decide the following question:

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* Reprinted from H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne 1902, pp.-535-537. (Only one of the maps mentioned in this award is reprinted)

** Reproduit de H. La Fontaine, *Pasicrisie Internationale: Histoire Documentaire des Arbitrages Internationaux (1794-1900)*, Imprimerie Stampelli & CIE, Berne 1902, pp. 535-537.

What level of its waters shall be taken to determine the shore line of Lake Nicaragua, parallel to which and 2 miles distant therefrom the boundary line must be traced, from near the San Juan River to the Sapoa?

It will facilitate discussion to define in advance the principal levels which must be frequently referred to. Under the influence of rainy seasons of about seven months and dry seasons of about five the level of Lake Nicaragua is in constant fluctuation. We shall have to discuss five different stages.

First. Extreme high water, the level reached only in years of maximum rainfall or some extraordinary conditions.

Second. Mean high water, the average high level of average years.

Third. Mean low water, the average low level of average years.

Fourth. Extreme low water, the lowest level reached in years of minimum rainfall or other extraordinary conditions.

Fifth. Mean water, the average between mean high water and mean low water.

The argument presented to me in behalf of Nicaragua claims that the level to be adopted in this case should be the first level named, to wit extreme high water. It argues that this line and this alone, is the true limit of what the argument calls the bed of the lake. Costa Rica claims the adoption of the third level, to wit, mean low water. This is argued principally upon two grounds: First, it is shown by a great number of legal decisions that in most States all water boundaries are invariably held to run at either extreme or mean low water. Second, it is claimed that in case of any doubt Costa Rica is entitled to its benefit, as she is conceding territory geographically hers.

I will begin with Costa Rica's first argument. The equity of adopting a low water line in the case of all water boundaries is readily admitted, even though instances of contrary practice exist.

Between all permanent lands and permanent waters usually runs a strip of land, sometimes dry and sometimes submerged. We may call it, for short, semisubmerged. Its value for ordinary purposes is much diminished by its liability to overflow, but, as an adjunct to the permanent land, it possesses often very great value. If the owner of the permanent land can fence across the semisubmerged he may save fencing his entire water front. He also can utilize whatever agricultural value may be in the semisubmerged land in dry seasons. Both of these values would be destroyed and wasted if the ownership were conferred upon the owner of the water. Therefore equity always and law generally, confers it upon the owner of the permanent land.

I recognized and followed this principle in my award No. 3, where I held that the boundary line following the right bank of the San Juan River, below Castillo, follows the lowest water mark of a navigable stage of river. And, if now the lake shore were itself to be the boundary of Costa Rica, I would not hesitate to declare that the semisubmerged land went with the permanent land and carried her limits at least to the mean low water line.

But this case is not one of a water boundary, nor is it at all similar, or on all fours with one, for none of the equities above set forth have any application. It is a case of rare and singular occurrence and without precedent within my knowledge. A water line is in question, but not as a boundary. It is only to furnish starting points whence to mesure off a certain strip of territory. Clearly the case stands alone, and must be governed strictly by the instrument under which it has arisen. That is the treaty of 1858, and its language is as follows:

> "Thence the line shall continue toward the river Sapoa, which discharges into the Lake Nicaragua, following a course which is distant always 2 miles from the right bank of the river San Juan, with its sinuosities, up to its origin at the lake, and from the right bank of the Lake itself up to the said river Sapoa, where this line parallel to the said bank will terminate."

The principles, upon which the language and intent of treaties are to be interpreted, are well set forth in the Costa Rica argument by many quotations from eminent authors. All concur that words are to be taken as far as possible in their first and simplest meanings — "in their natural and obvious sense, according to the general use of the same words", "in the usual sense, and not in any extraordinary or unused acceptation".

We must suppose that the language of the treaty above quoted suggested to its framers some very definite picture of the lake with its banks and of the 2 miles strip of territory. It evidently seemed to them all so simple and obvious that no further words were necessary. Let us first call up pictures of the lake at different levels and see which seems the most natural, obvious and reasonable.

The very effort to call up a picture of the lake at either extreme high water or at extreme low water seems to me immediately to rule both of these levels out of further consideration. Both seem unnatural conditions, and I must believe that had either been intended, additional details would have been given.

Next, is the mean low water mark the first, most obvious and natural picture called up by the expression "the bank of the lake"? It seems to me decidedly not. During about eleven months of the year this line is submerged, invisible and inaccessible. It seems rather a technical line than a natural one. The idea of a bank is of water limited by dry land with some elements of permanency about it. Even during the brief period when the line is uncovered the idea of it is suggestive far more of mud and aquatic growths than of dry land and forest growths.

To my mind, the natural, simple and obvious idea of the bank of a lake in this climate is presented only by the line of mean high water. Here we would first find permanent dry ground every day of an average year. Here an observer, during every annual round of ordinary seasons, would see the water advance to his very feet and then recede, as if some power had drawn the line and said to the waters, "Hitherto shalt thou come, but no further". Here the struggle between forest growths and aquatic vegetation begins to change the landscape. Here lines of drift, the flotsam and jetsam of the waves, naturally suggest the limits of the "bed of the lake".

One level of the lake remains for discussion, the mean level, or average of all waters. In a different climate, where the rainfall is more uniformly distributed throughout the year, the mean high water and mean low water lines, with all their respective features, would approach each other, tending to finally merge in the line of mean water. But, where wet and dry seasons prevail, as in the present case, the line of mean water is destitute of all obvious features, and is submerged for many months of the year. It is purely a technical and not a natural line, and is not to be understood where not expressly called for.

In argument against Nicaragua's claim of the extreme high water line, Costa Rica appeals to the general custom of geographers and scientific men in making ordinary topographical maps, who never adopt the extreme lines of overflows for the outlines of lakes. This argument of general custom has great weight but it is equally against Costa Rica's claim for the mean low water line. Wherever wet and dry seasons prevail, general custom treats mean high water as the normal state, always to be understood where no other level is expressed, and the line is assumed as the lake boundary in all ordinary topographical maps. Two quotations from Commander Lull's report of his Nicaraguan Canal survey will illustrate "Report Secretary of the Navy, 1873, p. 187":

> "In a survey made by Mr. John Baily, many years since, that gentleman professed to have found a pass with but 56 feet above the lake level, but the most of his statements are found to be entirely unreliable... For example, he finds Lake Nicaragua to be 121 feet above mean tide in the Pacific, while the true difference of level is but 107 feet." (Ibid., p. 199.)

> "The surface of Lake Nicaragua is 107 feet above mean tide in either sea."

From comparison of this level with the levels found by other surveys, there is no question that this figure was Lull's estimate of mean high water, as shown by his line of levels.

From every consideration of the lake, therefore, I am driven to conclude that the shore line of the lake contemplated in the treaty is the mean high water line.

I am led to the same conclusion also from the standpoint of the 2 miles strip of territory.

The treaty gives no intimation as to the purpose of this concession, and we have no right to assume one, either political or commercial. We have only to observe the two conditions put upon the strip in the treaty. Under all ordinary conditions it must be land, and 2 miles wide. This would not be the case if we adopted the line of either mean low water or mean water. In the former case the strip would be too narrow for about eleven months of an ordinary year: in the latter case for about five months.

Without doubt, then, I conclude that mean high water mark determines the shore of the lake and it now remains to designate that level and how it shall be found.

Several surveys of the proposed Nicaraguan Canal route besides that of Commander Lull above quoted, have been made within the last fifty years. Each found a certain mean high level of the lake, and it might seem a simple solution to take an average of them all, but, as each adopted its own bench mark on the ocean and ran its own line of levels to the lake, I have no means of bringing their figures to a common standard. It seems best, therefore, to adopt the figures of that one which is at once the latest and most thorough, which has enjoyed the benefit of all of the investigations of all of its predecessors, and whose bench marks on the lake are known and can be referred to. That is the survey, still in progress, under the direction of the United States Canal Commission. Its results have not yet been made public, but, by the courtesy of Rear Admiral J. G. Walker, President of the Commission, I am informed of them in a letter dated July 10, 1899, from which I quote:

> "In reply I am cabling you to-day as follows: 'Alexander, Greytown, six,' the six meaning, as per your letter, 106 as mean high level of lake. This elevation of 106 is, to the best of our knowledge (Mr. Davis, our hydrographer) the mean high water for a number of years... The highest level of the lake in 1898 was 106.7, last of November. The elevation of our bench mark on inshore end of boiler at San Carlos is 109.37."

A complete copy of this letter will be handed you and also blue prints of the maps made by the Commission of the lower end of the lake, which may facilitate your work.

As this Commission is the highest existing authority, I adopt its finding and announce my award as follows:

The shore line of Lake Nicaragua, at the level of 106 feet, by the bench marks of the United States Nicaragua Canal Commission, shall be taken as the bank of said lake referred to in the treaty of 1858[1].

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[1] *Monthly Bulletin of the Bureau of the American Republics*, 1899, vol. VII, p. 877.

Annex 7

Agreement on Border Protected Areas, between Costa Rica and Nicaragua, "SI-A-PAZ" agreement, signed at Puntarenas, Costa Rica.

15 December 1990

AGREEMENT ON PROTECTED BORDER AREAS

The Governments of the Republics of Costa Rica and Nicaragua

Whereas:

1. The International System of Protected Areas for Peace (SI-A-PAZ), in the border area of Costa Rica and Nicaragua, voices the widespread feeling of our nations and governments in order that permanent peace may be achieved in Central America;

2. The System and its scientific basis had their origin in the First Central American Meeting on Management of Natural and Cultural Resources, held in San Jose, Costa Rica in December 1974;

3. At the 17th General Assembly of the International Union for Conservation of Nature held in Costa Rica in February 1988, an agreement was made to support the negotiations carried out by the Governments of Costa Rica and Nicaragua to consolidate the SI-A-PAZ;

4. To this end, both countries have national commissions comprising government and non-government representatives, and have technical personnel working full-time on the SI-A-PAZ;

5. In October 1990 a binational meeting was held in Managua in which the framework for the funding in both countries of the SI-A-PAZ was established, and it was agreed that the respective Ministers of Natural Resources would sign a sectorial agreement in order to be able to develop projects in the SI-A-PAZ;

6. At the abovementioned meeting a top-level Binational Commission was set up in order to deal with all aspects related to the SI-A-PAZ, and several projects of a binational, homologous and national nature were identified for their development in the SI-A-PAZ;

7. The largest example of a tropical rainforest located along Central America's Caribbean coast will be fully protected in the SI-A-PAZ;

8. The area has an extraordinary diversity of habitats such as rainforests and riversides, rivers, lagoons and wetlands, as well as a vast wealth and diversity of fauna, and major potential for ecotourism;

9. The area is inhabited by marginalized rural groups that have been unable to achieve sustainable development due to a lack of financial resources and technical advice;

10. There is an interest and the political will to put into practice projects for national and sustained management of natural resources, with respect for the sovereign rights of each country, in order to improve the quality of life of the local populations and those of both countries in general.

Therefore:

Agree:

1. To declare the SI-A-PAZ the highest priority conservation project in both countries;

2. To request that the International Union for Conservation of Nature declare the SI-A-PAZ one of the most important conservation and sustainable development projects in Central America;

3. To request the support of the Scientific and International Conservationist community, and that of the donor countries and organizations, in order to implement the binational, homologous and national projects that the Binational Commission of the SI-A-PAZ has identified for both countries;

4. To request that the International Union for Conservation of Nature's Regional Office for Central America continue its technical and financial support for the SI-A-PAZ.

Signed in Puntarenas, on the 15th of December 1990.

Rafael Angel Calderon Fournier — President of Costa Rica

Violeta Barrios de Chamorro — President of Nicaragua

Annex 8

Nicaraguan Executive Decree 527, 17 April 1990,
published in Official Gazette Nº 78.

23 April 1990

CREATION OF PROTECTED NATURAL AREAS IN SOUTHEAST NICARAGUA

Decree No. 527 of April 17, 1990

Published in Gazette No. 78 of 23 April 1990

THE PRESIDENT OF THE REPUBLIC OF NICARAGUA

In exercising the powers vested upon him,

Whereas:

I

Pursuant to article 60, Chapter III, of the Political Constitution of Nicaragua, it is a duty of the Revolutionary Government and a right of Nicaraguans the preservation of the environment, protection and proper exploitation of our natural resources and those sites and territories that constitute important or unique elements of the natural patrimony of the country, for the purpose of promoting and regulating its rational use, pursuing a sustainable development model that contributes to better living standards of our people, scientific research, education, production, recreation and peace.

II

A group of areas exist in the natural ecosystems of southeast Nicaragua with different categories of management and use and a variety of resources of important ecological, economic and scientific value that should be protected.

III

Natural resources and tropical humid forests, for wanting of knowledge regarding their biological, economic and scientific importance, historically have been subject to continuous deterioration, wherefore it is necessary to develop actions to manage and protect the few reserves that exist on the planet.

IV

The purpose is to harmonize the socioeconomic development of Nicaragua, particularly in southeast Nicaragua, with the conservation and rational use of the natural resources contained in this part of the national territory, with the objective of contributing to a socially just and environmentally healthy model.

V

The IRENA Organic Law and the Law for the Creation of National Park Services in force empower and regulate the creation and management of Protected Natural Areas, such as national parks, national monuments, refuges and reserves.

DECREES:

CREATION OF PROTECTED NATURAL AREAS IN SOUTHEAST NICARAGUA

Article 1. The Southeast Protected Natural Areas are hereby created, with an unalienable character, located and comprised within the boundaries described below:

a) Solentiname National Monument in the area occupied by the Solentiname Archipelago, considered as a special area for environmental management and recovery given its natural, historical and cultural importance.

The area has a territorial extension of 189.3 square kilometres. It is located in the southeast corner of the Great Lake of Nicaragua. The description of this boundary comprises approximately one kilometre of waters adjacent to the Archipelago, beginning at a point located at 1241.2 North latitude, continuing east 12.4 kilometres to a point located at 122 West longitude and 1241.2 North latitude, continuing 18.2 kilometres southeast to a point located at 733 West longitude and 1225.4 North latitude, turning four kilometres southeast up to a point located at 730 West longitude and 1224 North latitude, continuing 11 kilometres northeast up to a point located at 722.8 West longitude and 1232.2 North latitude, continuing 13.2 kilometres west up to a point located at 709.6 West longitude and 1232.4 North latitude, continuing 8.8 kilometres north to the starting point of this description.

b) The area of Los Guatuzos Wildlife Refuge in the wetlands of Lake Nicaragua is a nesting, breeding and protection zone for a large variety of flora and fauna species, as well as for scientific research, and involves some controlled human activity.

The area covers approximately 437.5 square kilometres. This description begins at the mouth of the Pizote River in Lake Cocibolca at 609 West longitude and 1227.4 North latitude. This boundary runs east over the lakeshore up to the town of San Carlos at the origin of the San Juan River, thence continues downstream the San Juan River up to its confluence with the Medio Queso River, following the course of this river up to the boundary line at 7.55 West longitude and 1225 North latitude, thence continues over the boundary line, passing markers number 12 and 13, up to the point where the Pizote River crosses the border between Nicaragua and Costa Rica at 609 West longitude and 1221.4 North latitude, thence proceeds north along the course of the river up to the starting point of this description.

c) The Historical Monument "Fortaleza de la Inmaculada" is an area of great historical and tourism importance. It has a territorial extension of approximately 37.5 square kilometres. The description of this boundary begins at marker number 6 of the border between Nicaragua and Costa Rica at 778 West longitude and 1212 North latitude, from where it proceeds downstream the Poco Sol River up to its mouth in the San Juan River, thence proceeds downstream the course of the latter up to marker number 2 of the aforementioned border at 188 West longitude and 1217 North latitude, thence proceeds southwest over the border, passing markers number 3, 4 and 5, up to marker number 6, the starting point of this description.

d) The San Juan River-Indio-Maíz Great Biological Reserve, covering approximately 2,950 square kilometres, is an area of great national and international importance given that it contains one of the few reserves in the planet of virginal tropical humid forests of great interest for the scientific community.

It comprises forest areas, the boundaries of which begin at the mouth of the Bartola River in the San Juan River at 791 West longitude and 1214 North latitude, continuing upstream the Bartola River up to its origin north of

Cerro El Diablo at 805 West longitude and 1223 North latitude, continuing along the water parting that divides the basins of the Indio River with that of Bartola and San Cruz, passing by Cerro Romerón at a point located at 797 West longitude and 1229 North latitude until it reaches an altitude at 804 West longitude and 1243 North latitude. The boundary turns northeast over the water parting that divides the basins of the Maíz and Agua Zarca rivers, passing an altitude at 813 West longitude and 1254 North latitude up to Cerro Chiripa at 819 West longitude and 1253 North latitude, thence continues north, always over the waters parting the basins to an altitude located at 818 West longitude and 1260 North latitude.

Thence the boundary turns northeast over the waters parting the basins of the Maíz and Pijibaye rivers up to an elevation of 237 meters at 181 West longitude and 1265 North latitude. The boundary continues northeast in a straight line up to the mouth of Caño Hondo in the Atlantic Ocean at a point located at 192 West longitude and 1267 North latitude.

(…)

Article 5. IRENA is authorized to draft the preliminary regulations of this law and to submit them to the President of the Republic for approval.

Article 6. This Law shall take effect on the date of its publication in any mass media, without prejudice to its subsequent publication in the official bulletin “La Gaceta”.

Done at Managua City on the sixteenth of April of nineteen ninety, “Year of Peace and Reconstruction”, Daniel Ortega Saavedra, President of the Republic.

Annex 9

The Borderline Corridor Conformed by the Territories Encompassed along the Border with Nicaragua, from Punta Castilla in the Caribbean Sea up to Salinas Bay in the Pacific Ocean is Hereby Declared as a National Wildlife Refuge
Nº 22962 – MIRENEM

15 February 1994

The Borderline Corridor Conformed by the Territories Encompassed along the Border with Nicaragua, from Punta Castilla in the Caribbean Sea up to Salinas Bay in the Pacific Ocean is Hereby Declared as a National Wildlife Refuge

Nº 22962 – MIRENEM

THE PRESIDENT OF THE REPUBLIC

AND THE MINISTRY OF NATURAL RESOURCES, ENERGY AND MINES,

Pursuant to the authority conferred by Article 140, Subparagraphs 3) and 18) of the Political Constitution and Articles 82 and 84 of the Wildlife Conservation Act, Nº 7317, dated October 30, 1992.

Whereas:

1. The State is compelled to watch over the protection of the natural resources of the country.

2. Through Act Nº 13, General Law on Vacant Lots, issued on January 6, 1939, Article 10 and Act N2 2825 and its Reforms, Article 7, Subparagraph f), created an inalienable public area of 2,000 meters wide along the border with Nicaragua. By virtue of the provisions set forth in the pronouncements issued by the Attorney General's Office of the Republic, Nº C107-85 and Nº C272-85, dated May 20, 1985 and October 29, 1985 respectively, management of this area is granted either to the Agricultural Development Institute (as long as the plots are apt for agricultural use), and to the Ministry of Natural Resources, Energy and Mines (as long as the plots are apt for forestry development).

3. The referred to area now constitutes a very important biological corridor between the Tortuguero Conservation Area, the Tamborcito and Maquenque Wetlands, the Caño Negro National Wildlife Refuge, and El Jardin Forest Reserve.

4. Pursuant to the agreement on Border Areas, subscribed by the Governments of the Republics of Costa Rica and Nicaragua in Puntarenas on December 15 of the year 1990, the International System of Protected Areas for Peace (SI-A-PAZ), hereby declared as a conservation project of the utmost priority in both countries.

5. SI-A-PAZ intends to protect the largest and most representative sample area of tropical rainforest found in the Central American Caribbean Basin.

6. Advancement of commercial single crops and illegal tree felling reduced the forest area of the northern basin to critical levels, with the consequent deterioration of the wildlife habitats, loss of biodiversity, sedimentation of the natural watercourses and advanced erosion processes. Therefore,

DECREE:

Article 1: The border corridor conformed by the plots of land encompassed in an area of 2,000 meters wide along the border with Nicaragua, from Punta Castilla on the Caribbean Sea up to Salinas Bay on the Pacific Ocean, hereby declared as a National Wildlife Refuge, pursuant to the provisions in the Cañas-Jerez Treaty of April 15, 1858.

Article 2: Owners and occupiers and other non-landowners, as well as tenants of the Agricultural Development Institute in the areas encompassed within the National Wildlife Refuge created by this Executive Decree, only deemed as part of it until the State purchases or expropriates their rights. In the meantime, they will continue to enjoy the attributes of their property, possession or lease.

Article 3: The Directorate General for Wildlife of the Ministry of Natural Resources, Energy and Mines will manage the Refuge.

Article 4: Enters into effect as of its publication.

Given in the Presidency of the Republic – San Jose, on the fifteenth day of the month of February of the year nineteen hundred and ninety-four

Annex 10

Nicaraguan Decree No. 66-99, “Update and Definition of categories and limits of Protected Areas located in Nicaragua’s southeast territory.”

31 May 1999

DECREE No. 66-99 passed on 31 May 1999.

Published in the Gazette, Official Bulletin No. 116 of 18 June 1999.

THE PRESIDENT OF THE REPUBLIC OF NICARAGUA,

WHEREAS

The General Law on the Environment and Natural Resources and regulations thereof, the Law on the Organization, Competence and Procedures of the Executive Branch and Regulations on Protected Areas being in force, which constitute the framework of the Integrated System of Protected Areas for Peace (SIAPAZ), it is convenient to adjust existing regulations on protected areas in the southeast territory of Nicaragua to said legal instruments.

II

Article 154 of the General Law on the Environment and Natural Resources confers powers to the Ministry of the Environment and Natural Resources to update and delineate the boundaries and categories of the National System of Protected Areas, and Article 98 of the Regulations on Protected Areas provides that said adjustments shall be made by decree.

THEREFORE

In exercising the powers conferred by the Political Constitution of the Republic of Nicaragua,

HAS ISSUED

The following Decree:

UPDATE AND PRECISION OF CATEGORIES AND BOUNDARIES OF PROTECTED AREAS LOCATED IN THE SOUTHEAST TERRITORY OF NICARAGUA.

Article 1. PURPOSE. The purpose of this Decree is to update and delineate the categories and boundaries of Protected Areas located in the southeast territory of Nicaragua pursuant to the General Law on the Environment and Natural Resources No. 217, published in Official Gazette No. 105 of 6 June 1996, and Decree No. 14-99 regarding Regulations on Protected Areas of Nicaragua, published in Official Gazettes No. 42 and 43 of March 2 and 3, 1999, respectively.

Article 2. CATEGORIES OF PROTECTED AREAS. Pursuant to articles 20, numeral 7) and 154 of the General Law on the Environment and Natural Resources 217, and articles 8, numeral 7), 98 and 99, respectively, of Decree No. 1499 regarding Regulations on Protected Areas, the following categories of Protected Areas in the southeast territory of Nicaragua are updated and delineated:

1. “Los Guatuzos” Wildlife Refuge to “Los Guatuzos” Wildlife Refuge areas;

2. “Solentiname Archipelago” National Monument to “Solentiname” National Monument;

3. Historical Monument "Fortaleza de la Inmaculada Concepción de Maria" to Historical Monument “Fortaleza Inmaculada” area;

4. “Cerro Silva” Natural Reserve to “Cerro Silva” Natural Protected Areas of National Interest;

5. “Indio Maíz” Biological Reserve to the part of the San Juan River-Indio Maíz Great Biological Reserve that possesses said category;

6. “Punta Gorda” Natural Reserve to the part of the San Juan River-Indio Maíz Great Biological Reserve that possesses said category; and

7. "San Juan River" Wildlife Refuge to the part of the San Juan River-Indio Maíz Great Biological Reserve that possesses said category.

Article 3. BOUNDARIES OF PROTECTED AREAS LOCATED IN THE SOUTHEAST TERRITORY OF NICARAGUA. For all purposes, the following Protected Areas are updated and delineated:

1. "Los Guatuzos" Wildlife Refuge This refuge comprises some marshes or wetlands of Lake Nicaragua. Since it is a nesting, breeding and protection zone for a great variety of flora and fauna, it is suitable for scientific research and involves certain controlled human activity. It has a territorial extension of 437.5 square kilometres and it is located within the following metes and bounds:

The boundary begins at the mouth of the Pizote River in Lake Cocibolca at UTM coordinates 122 6670 N, 697 900 E. It continues along the lakeshore, in direction to the east, up to the town of San Carlos, where it flows into the lake and gives origin to the San Juan River up to its confluence with the Medio Queso River. It continues upstream along the course of this river until it reaches the border at the point of intersection located at 1225000 N (northing) 755000 E (easting). It continues along the border line, passing markers 12 and 13, until it reaches the intersection of the Pizote River with the border between Nicaragua and Costa Rica at 1221400 N, 699000 E, continuing north downstream the course of the river up to the starting point of this description.

2. "Solentiname Archipelago" National Monument. Located in Lake Nicaragua, it is a special area of environmental management and recovery given its natural, historical and cultural importance. It has a territorial extension of 189.3 square kilometres, and it is located within the following metes and bounds:

The area is located at the southeast corner of Lake Nicaragua. The description of this boundary comprises approximately 1 kilometre of waters adjacent to the Archipelago. The boundary begins at UTM coordinates 1241000 N, 722000 E, thence proceeds southeast to a point located at 1225000 N, 733000 E, thence proceeds southwest to a point located at 1224000 N, 730000 E, thence runs northwest to a point located at 1232000 N, 722000 E, thence continues west to a point located at 1232000 N, 710000 E, thence proceeds north to a point located at 1242000 N, 710000 E, and thence continues east to a point located at 1241000 N, 722000 E, the starting point of this description.

3. Historical Monument "Fortaleza de la Inmaculada Concepción de María" has a territorial extension of 37.5 square kilometres, and it is located and comprised within the following metes and bounds:

The boundary begins at Marker No. 6 on the border between Nicaragua and Costa Rica at UTM coordinates 1212650 N, 678600 E, thence continues downstream the Poco Sol River up to its outlet into the San Juan River, thence continues downstream along the course of the latter up to Marker No. 2 of the aforesaid border at 1216700 N, 788550 E, thence proceeds southwest along the border, passing Markers No. 3, 4, 5 and 6 at 1212650 N, 678600 E, the starting point of this description.

4. "Cerro Silva" Natural Reserve. Established as a Forestry Reserve, it is comprised within the following natural boundaries: Escondido River, Mahogany River, Cerro Silva, Cerro Cabeceras del Kukra, the confluence of the Serrano and Chiquito rivers, the confluence of the Mora and Punta Gorda rivers, and Punta Gorda River up to its outlet into the sea. It has a territorial extension of 3,394 square kilometres, and it is located and comprised within the following metes and bounds:

Cerro Silva Natural Reserve shall be comprised within the following perimeter:

NORTH: From the mouth of the Escondido River on the north bank in the Bay of Bluefields, it proceeds upstream up to its confluence with the Mahogany River; WEST: It proceeds upstream the Mahogany River up to its source where it crosses the municipal border of Nueva Guinea at 1315150 N, 803960 E. From this point, it continues in a straight line up to its confluence with the Piedra Fina River at 1308770 N, 801600 E, thence continues upstream to a point located at 1306810 N, 804540 E, thence continues southeast in a straight line to its intersection with the highest point (405 meters above sea level) of the hill where the headwaters of the Kukra River begin. From this point, it continues south in a straight line up to its confluence with an affluent of the Chiquito River at 1295235 N, 806490 E, thence continues downstream along this course up to its confluence with the Chiquito River, thence continues downstream up to its confluence with the Serrano River. From this point, it proceeds southeast in a straight line, passing by the highest point (285 meters above sea level) until it crosses the Mora River at 1275550 N, 804595 E, thence continues downstream along this course up to its confluence with the Punta Gorda River.

SOUTH: Punta Gorda River to its outlet into the Caribbean Sea. From this point, it proceeds northeast along the coast up to the outlet of the Escondido

River on the northern bank of the Bay of Bluefields, the starting point of this description.

Excluding the town of Bluefields, it is comprised within the following boundaries (UTM coordinates: Zone 17): The boundary begins at the Sconfra River at N 1333700, E 195940, thence proceeds downstream said river up to one of its headwaters at 1325450 N, 194650 E. From this point, it proceeds south in a straight line up to its intersection with one of the headwaters of the Musulaina Creek River at 1323975 N, 194670 E. From this point, it continues downstream said river up to its mouth at the Bay of Bluefields, then proceeds northeast along the coast, passing the town of Bluefields, up to a point located at 133 3700 N, 195 940 E, the starting point of this description.

5. "Indio Maíz" Biological Reserve. The reserve covers 2,639.8 square kilometres, and it is located and comprised within the following metes and bounds: The boundary begins at the Bartola River at UTM coordinates 1214950 N, 792400 E, thence continues downstream along the Bartola River up to a point at 1216627 N, 797554 E. From this point, it proceeds north along the trail passing by the following coordinates:

N	E
1217627	797428
1218627	797453
1219627	797402
1220627	797348
1221627	797301
1222627	797247
1223627	797196
1224627	797139
1225627	797079
1226625	797022
1227122	796353
1227953	796901
1228802	797450
1229641	798004
1230522	798423
1231515	798497
1232407	798948
1233305	799401
1233472	800365
1233592	801367

1234416	801163
1235348	800793
1236261	800853
1237185	801240
1238160	801447
1239144	801651
1240123	801817
1241116	801765
1242116	801720
1243116	801671

Until it crosses the Aguas Zarcas River at 1243968 N, 801639 E, thence continues downstream until it crosses the La Venada channel of said river at 1251700 N, 806750 E. From this point, it continues upstream up to its headwaters at 1252150 N, 809300 E, thence proceeds northeast, passing over altitudes of 461 m.a.s.l. and 413 m.a.s.l., up to the Piedra Fina River at 1256625 N, 813550 E. From this point, it proceeds upstream until it crosses an affluent of said river at 1256700 N, 814850 E. The boundary thence continues upstream up to a point located at 1256800 N, 816850 E. From this point, it proceeds northeast, passing over altitudes of 388 m.a.s.l, 474 m.a.s.l. and 491 m.a.s.l., up to one of the headwaters of the Pijibay River at 1260500 N, 818500 E. From that point, it continues downstream the Pijibay River, always 1,000 meters south, respectively, to the right bank of the same river up to the mouth in the Punta Gorda River, proceeds southwest over the coast up to a point at N 123 5675, E 189 235 (zone 17), thence proceeds west in a straight line until it crosses the north boundary of the El Pescado Lagoon at 1235675 N, 189000 E (zone 17). The boundary continues southwest from El Pescado Lagoon until it crosses the Ebo River, thence continues upstream along said river until it crosses the Pampy River. From this point, it proceeds downstream the Pampy River until it crosses the Indio River, thence continues upstream said river up to its confluence with the Casa Alta River, thence proceeds upstream said river until it crosses the wetland at 1210750 N, 196500 E (zone 17), thence proceeds southwest along the edge of the wetland until it crosses again the Casa Alta River at 209825 N, 195650 E (zone l7), thence proceeds upstream the Casa Alta River until it crosses again the wetland at l209075 N, 194705 N (zone 17), thence proceeds north along the edge of the wetland until it crosses a river (without name) at 1211200 N, 192240 E (zone 17), thence proceeds northeast, downstream the river, until it crosses again the wetland at 1211100 N, 192550 E (zone 17), thence runs along the wetland until it crosses another river (without name) at 1208000 N, 191800 E (zone 17), thence proceeds downstream until it crosses again the wetland at 1208125 N, 192430 E (zone 17), thence continues along the edge of said wetland until it crosses the Caño Deseado River at 1206440 N, 191160 E (zone 17), thence proceeds downstream along said river where it crosses the wetland at 1207180 N, 192670 E (zone 17). The boundary thence proceeds along the wetland until it crosses the San Juanillo River at 1206260 N, 194950 E (zone 17), thence proceeds downstream said river until it crosses again the wetland at 1205700 N, 194800 E (zone 17), thence continues southeast over the wetland until it crosses the El Misterioso River at 1203650 N, 195350 E (zone 17), thence proceeds upstream said river until it crosses again the wetland at 120025 N, 194900 E (zone 17). From this point, it continues over the wetland until it crosses again the El Misterioso River at 1203650 N, 195370 E (zone 17), thence continues downstream until it crosses again the wetland at 1203025 N, 194900 E (zone 17), thence continues along the edge of the wetland until it crosses the Silico Lagoon at 1202480 N, 199450 E (zone 17), thence proceeds southwest, upstream the Silico Lagoon, along the edge of the lagoon and wetland up to a point located at 1199250 N, 199160 E (zone 17). From this point, it proceeds southeast in a straight line where it crosses a contour, 10 meters above sea level, at 1199050 N, 199300 E (zone 17), thence proceeds along the contour until it crosses the wetland at a point located at 1196450 N, 201400 E (zone 17). From this point, it continues south along the edge of the wetland up to a point located at 1195801 N, 201750 E (zone 17). From this point, it continues southwest a distance of two kilometres from the south bank of the San Juan River up to the Bartola River at 1214950 N, 792400 E, the starting point of this description.

6. "Punta Gorda" Natural Reserve. This reserve is part of the former San Juan River-Indio Maíz Great Biological Reserve. It has a territorial extension of 549 square kilometres and it is located and comprised within the following metes and bounds:

The boundary begins at the confluence of the Punta Gorda River with the Pijibay River at UTM coordinates 1269250 N, 185375 E (zone 17). From this point, it proceeds southwest upstream the Punta Gorda River up to its confluence with the Agua Zarca River at 1272825 N, 804750 E, thence continues upstream said river until it crosses a river (without name) at 1251700 N, 806750 E. From this point, it proceeds upstream up to its origin at 1252150 M, 809300 E, thence proceeds northeast, passing over altitudes of 461 and 413 meters above sea level, up to the Piedra Fina River at 1256625 N, 813550 E. From this point, it continues upstream until it crosses an affluent of said river at 1256700 N, 14850 E, thence continues upstream up to a point located at 1256800 N, 816850 E. From this point, it proceeds northeast, passing over altitudes of 388, 474 and 491 meters above sea level, up to one of the headwaters of the Pijibay River at 1260500 N, 818500 E. From this point, it continues downstream the Pijibay River, always at a distance of 1,000 meters south from the right bank of the same river, up to its confluence with the Punta Gorda River at 1269250 N, 185375 E (zone 17), the starting point of this description.

7. "San Juan River" Wildlife Refuge is part of the former San Juan River-Indio Maíz Great Biological Reserve and covers 430 square kilometres. It is located and comprised within the following metes and bounds:

The boundary begins at the Bartola River at UTM coordinates 214950 N, 792400 E. From this point, it proceeds downstream the Bartola River until it crosses the north bank of the San Juan River at 1214050 N, 790700 E. From this point, it proceeds west until it crosses the south bank of the San Juan River at 1214050 N, 790450 E. From this point, it continues downstream the San Juan River, along the border with the Republic of Costa Rica, up to the Caribbean Sea at 209500 N, 208650 E. From this point, it proceeds northwest over the coast up to 1235675 N, 189235 E (zone 17), thence proceeds west in a straight line until it crosses the north bank of the El Pescado Lagoon at 1235675 N, 189000 E (zone 17), thence proceeds southwest from the El Pescado Lagoon until it crosses the Ebo River, thence continues upstream said river until it crosses the Pampy River. From this point, it proceeds downstream the Pampy River until it crosses the Indio River, continuing upstream said river up to its confluence with the Casa Alta River. It continues upstream along said river until it crosses the wetland at N 121 0750, E 196 500 (zone 17). It continues southwest along the edge of the wetland until it crosses again the Casa Alta River at N 120 9825, E 195 650 (zone 17). It continues upstream along the Casa Alta River until it crosses again the wetland at N 120 9075, N 194 705 (zone 17). It continues north along the edge of the wetland until it crosses a river (without name) at N 121 1200, E 192 240 (zone 17). It proceeds northeast, downstream along the river, until it crosses again the wetland at N 121 1100, E 192 550 (zone 17), continuing along the wetland until it crosses another river (without name) at N 120 8000, E 191 800 (zone 17). It continues downstream until it crosses again the wetland at N 120 8125, E 192 430 (zone 17), continuing along the edge of said wetland until it crosses the Caño Deseado River at N 120 6440, E 191 160 (zone 17). It continues downstream along said river where it crosses the wetland at N 120 7180, E 192 670 (zone 17). The boundary continues along the wetland until it crosses the San Juanillo River at N 120 6260, E 194 950 (zone 17), thence upstream said river until it crosses again the wetland at N 120 5700, E 194 800 (zone 17). It continues southeast over the wetland until it crosses the El Misterioso River at N 120 3650, E 195 350 (zone 17), thence continues upstream said river until it crosses again the wetland at 1203025 N, 194900 E (zone 17). From this point, it proceeds over the wetland until it crosses again the El Misterioso River at 203650 N, 195370 E (zone 17), thence continues upstream until it crosses again the wetland at 1203025 N, 194900 E (zone 17), thence continues along the edge of the wetland until it crosses the Silico Lagoon at 1202480 N, 199450 E (zone 17), thence proceeds southwest, upstream the Silico Lagoon, along the edge of the wetland and said lagoon up to 1199250 N, 199160 E (zone 17). From this point, it proceeds southeast in a straight line where it crosses a contour 10 meters above sea level at 1199050 N, 199300 E (zone 17), thence continues along the contour until it crosses the wetland at 1196450 N, 201400 E (zone 17).

From this point, it proceeds south along the edge of the wetland up to a pointed located at 1195800 N, 201750 E (zone 17). From this point, thence proceeds southeast, always at a distance of 2 kilometres from the south bank of the San Juan River, up to the Bartola River at 1214950 N, 792400 E, the starting point of this description .

(....)

Article 9. REPEALS. Decrees No. 527 and 28-94, published in Official Gazette No. 78 of April 23, 1990, and Official Gazette No. 106 of June 8, 1994, are hereby repealed, as well as any provision opposed thereto.

Article 10. EFFECTIVE DATE. This Decree shall take effect on the date of its publication in the Official Gazette.

Done at Managua, on the thirtieth of May of nineteen ninety-nine. ARNOLDO ALEMÁN LACAYO, President of the Republic of Nicaragua. ROBERTO STADTHAGEN VOGEL, Minister of the Environment and Natural Resources.

Annex 11

Official Daily Gazette No. 46, Decree No. 36440-MP, Year CXXXIII,
La Uruca, San José, Costa Rica.

7 March 2011

Official Daily Gazette No. 46

Decree No. 36440-MP

Year CXXXIII

La Uruca, San José, Costa Rica **Monday, 7 March 2011**

THE PRESIDENT OF THE REPUBLIC AND THE MINISTER OF THE PRESIDENCY

In the exercise of the authority conferred on them by Articles 140, sections 3) and 18) and 180 of the Political Constitution, Articles 25 section 1), 2.7 section 1) 28 section b), of Law No 6227 of 2 May 1978 which is the General Public Administration Law, and Law No. 8488 of 11 January 2006 which is the National Law on Emergencies and Risk Prevention.

Bearing in mind:

I.- That the constitutional system provides for special norms that allow the Executive Branch to address emergency situations so that action in that regard can be as agile and decisive as merited by the circumstances so as to discard or minimize the consequence wrought by natural and human made disasters.

II.- That the Costa Rican State has the essential function of the protection of national sovereignty, and in its preservation and defense the State is called upon to exercise all necessary measures in observance of the civil and pacifist vocation that guides the Costa Rican State, particularly those with regards to the abolition of the army, peace, neutrality and the peaceful settlement of disputes by the use the mechanisms provided by International Law.

III.- That the Ministry of Foreign Affairs is the vehicle by which the State carries out all its tasks before any foreign Governments and Institutions. Furthermore, the Ministry for Public Security is the entity responsible for defense of the territorial integrity of Costa Rica. Equally, other entities of the State will be available to provide institutional support, in conformity with their competence and responsibilities for those purposes.

IV.- That the military invasion and occupation of Costa Rica by Nicaragua, since October 2010, brought Nicaraguan troops that now occupy a part of the territory of Costa Rica, in clear violation of its national sovereignty, territorial integrity and dignity.

V.- That the aforementioned represents a constant violation of the territorial, aerial and maritime spaces of Costa Rica, thus impacting not only on its national sovereignty, but also causing serious environmental damage through the destruction of fragile national wetlands zones which are duly registered and recognized at the international level.

VI.- That to this day Nicaragua continues to occupy and damage a part of the Costa Rican territory with the presence of the Nicaraguan armed forces, in particular, in Isla Portillo-Isla Calero, and that it also continues to carry out dredging activity which has caused serious environmental damage to the abovementioned zone.

VII.- That as a result of actions carried out by the army of Nicaragua and the Government of that country, normal functioning conditions for activity in several Costa Rican communities along the border area, and of government institutions, have been disrupted, because some have even become isolated as they lack the means to access basic services such as health, food provisions, education, among others, and thus have been placed in an evident vulnerable situation.

VIII.- That the zone that has been affected by the actions of the Nicaraguan Government and Army is also under constant threat of natural phenomena that causes flooding among other effects.

IX.- That the National Law on Emergencies and Risk Prevention determines that "Those within the national territory should count with the protection of their life, their physical integrity, their property and the environment in the face of dangerous disasters or events that may occur."

X.- That the National Law on Emergencies and Risk Prevention defines as a disaster a situation "or process that unfolds as the result of a phenomenon with a natural, technological or man-made origin where a population is brought under conditions of vulnerability, that causes intense disruption of the community's normal functioning conditions, such as the loss of lives and health within the population, destruction or loss of the collective's property and severe damage to the environment."

XI.- That the National Law on Emergencies and Risk Prevention understands an emergency to be the crisis state created by the disaster.

XII.- That up until the present attention to the disaster created by the actions of the Army and Government of Nicaragua has been enabled by resources and the ordinary procedures that regulate Public Administration; however, at the present moment resort to mechanisms of exception provided by the Constitution and the Law is merited. **Therefore,**

THEY DECREE:

"TO DECLARE THAT THE SITUATION UNFOLDED BY THE VIOLATION OF COSTA RICAN SOVEREIGNTY ON THE PART OF NICARAGUA CONFORMS A STATE OF EMERGENCY"

Article 1- A State of Emergency is declared in the following villages on the border with Nicaragua: La Cruz, Upala, Los Chiles, Sarapiquí, San Carlos and Pocosi; and also the situations and/or processes that are being unleashed as a result of the activities illicitly carried out by Nicaragua on Costa Rican territory, which threaten the life, physical integrity and property of those within national territory, as well as the national sovereignty and the environment.

Article 2-. To that effect, the present declaration of a state of emergency includes the three phases established in the National Law on Emergencies and Risk Prevention which are as follow:

a) Response phase.
b) Rehabilitation phase.
c) Reconstruction phase.

Article 3.- The present declaration of a state of emergency encompasses all the actions and projects necessary for the protection of life, physical integrity, property and the environment, as well as those necessary for attention, 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, all of which actions should be included in the General Emergency Plan approved by the Governing Board of the National Commission on Risk Prevention and Attention to Emergencies, in order that such attention and projects take place in conformity with the concept of emergency.

Article 4.- In conformity with the stipulations of articles 15 and 38 and also the following articles of the National Law on Emergencies and Risk Prevention, the Ministry for Public Security will coordinate with the National Commission on Risk Prevention and Attention to Emergencies, the Center for Emergency Operations (COE by its Spanish acronym), and other coordination entities to facilitate the development of a General Emergency Plan.

Article 5.- In conformity with stipulations of the National Law on Emergencies and Risk Prevention, the Executive Branch, public institutions, autonomous and quasi autonomous entities, State corporations, municipalities, as well as any other entity or public organism are authorized to contribute, donate, transfer, and lend the necessary help and collaboration to the National Commission on Risk Prevention and Attention to Emergencies.

Article 6.- For implementation of the present declaration of an emergency, the National Commission on Risk Prevention and Attention to Emergencies, in conformity with the National Law on Emergencies and Risk Prevention may assign funds and accept donations from public and private entities.

Article 7-. As part of its attention to the present emergency, the National Commission on Risk Prevention and Attention to Emergencies may use unassigned funds remaining from other resolved or remaining emergencies as determined by the Governing Board of this entity.

Article 8-. The grounds of private property situated in the geographic area defined by this declaration of an emergency state shall be bound to allow all the legal easements necessary for the execution of these actions, processes and projects to be carried by public entities in response to the emergency, as along as these are indispensable to the opportune attention to the emergency in conformity with the stipulations of the Phase 1 of the emergency.

Article 9-. The present declaration of an emergency state will be in effect during the period of time determined by the Executive Branch, depending on reports issued by the National Commission on Risk Prevention and Attention to Emergencies, or during the maximum period of time established in Law 8488.

Article 10-. The present decree is in effect as of the moment of signature.

[The present decree was] signed in the Presidency of the Republic the twenty-first of February of the year two thousand eleven.

LAURA CHINCHILLA MIRANDA. – The Minister for the Presidency, Marco A. Vargas Díaz. – 1 time. – O.C. No. 10971. – (Request No. 030-2011). – C-64820. – (D36440-IN2011016261).

Annex 12

BY-LAWS AND REGULATIONS, PRESIDENCY OF THE REPUBLIC, NATIONAL COMMISSION ON RISK PREVENTION AND ATTENTION TO EMERGENCIES
Decision No. 0362 – 2011, SPECIFIC BY-LAWS REGARDING PURCHASING AND CONTRACTS PROCEDURES UNDER EXCEPTION MECHANISMS REGIMEN BY VIRTUE OF THE DECLARATION OF A STATE OF EMERGENCY BY VIRTUE OF DECREE NO. 36440.

21 September 2011.

Digital signature of: José Luis Vargas Espinoza Spanish acronym): sn: Vargas Espinoza physical person Espinoza/signature/	/signature/ Identification number (DN, by its Serial number: CPF 02-0255-0227, Given name: Jorge Luis,c-CR, or ou-citizen, cn- Jorge Luis Vargas Date: 2011-09-22, 14:27:50-06 '00'

[Illegible]	[Illegible]	[Illegible]

BY-LAWS AND REGULATIONS
PRESIDENCY OF THE REPUBLIC
NATIONAL COMMISSION ON RISK PREVENTION
AND ATTENTION TO EMERGENCIES
Decision No. 0362 – 2011
SPECIFIC BY-LAWS REGARDING PURCHASING AND CONTRACTS PROCEDURES UNDER EXCEPTION MECHANISMS REGIMEN BY VIRTUE OF THE DECLARATION OF A STATE OF EMERGENCY BY VIRTUE OF DECREE NO. 36440

Government of Costa Rica
BY LAWS AND REGULATIONS
PRESIDENCY OF THE REPUBLIC
NATIONAL COMMISSION ON RISK PREVENTION AND ATTENTION TO EMERGENCIES
Governing Board

DECISION No. 0362-2011

21 September 2011.
DECISION No. 0632-2011
SPECIFIC BY-LAWS REGARDING PURCHASING AND CONTRACTS PROCEDURES UNDER EXCEPTION MECHANISMS REGIMEN BY VIRTUE OF THE DECLARATION OF A STATE OF EMERGENCY BY VIRTUE OF DECREE No. 36440

BEARING IN MIND:

1. That in carry out the specific purchasing and contracting process necessary by virtue of the emergency resulting from the violation of Costa Rican sovereignty by Nicaragua, on Isla Calero in particular, as well as the environmental damage infringed on national territory, the declaration of an Emergency under Executive Decree No. 36440 a specific mechanism under said decree is required for purchasing and contracting processes.

2. That the specific nature of the event that created the emergency, which was an act of aggression on the part of the neighbor country of Nicaragua, imposes taking actions that are different from those generally carried out under the regimen of exception and under the control of the National Commission on Risk Prevention and Attention to Emergencies (from here on referred to as the Commission); the situation requires highly specialized criteria from the institutions responsible for attending to the problem, especially regarding characteristics of the equipment, supplies and services that have to be purchased or contracted.

3. That the By-laws Regarding Procedures for the Institutional Purchasing by the National Commission on Risk Prevention and Attention to Emergencies, published in *La Gaceta (The Gazette)* No. 172 of Thursday, 3 September 2009, is deficient regarding purchasing and contracting norms in the case of emergencies in which it is not possible to delineate the first-response phase, rehabilitation and reconstruction as established by article 30 of Law 8488. It is also deficient regarding the option of extending Executive Units the purview, under the exceptions mechanisms regimen, of institutional purchasing and contracting by these institutions.

4. That by reason of the former the present procedure has the purpose of allowing institutional purchasing by the entities appointed as Executive Units by the Governing Board of the Commission carry out the purchasing and contracting necessary for carrying out the General Emergency Plan, without undermining obligations of the Commission of administering National Emergency Fund regarding administration of designated resources, and to oversee procedures, project development and disbursements, under Law No. 8488, the Executive Units By-laws and the By-laws Regarding Procedures for the Institutional Purchasing by the Commission.

5. That under Law 8488, which regulates this Commission, the functions and scope of the Governing Board arise from its stipulations:

    a. By virtue article 180 of the Political Constitution and due to the budgetary constraints declaration of the emergency allows for procedural exceptions in order that the Government may swiftly obtain sufficient economic, material, or other resources necessary for safeguarding persons, property and services impacted upon by war, internal strife or public calamities. (art. 31)

    b. Declaration of an emergency is the option of the Executive Branch in order that it may resort to flexible and agile mechanisms that override the juridical order that regulates the ordinary activity of the Administration to address urgent and unforeseen needs of persons and protect property when surprise and unforeseen events take place, and even when they can be foreseen but are inevitable; unusual situations that generally cannot be controlled, managed or handled through ordinary measures.

       In the face of such events the immediate need to address human needs and protect endangered lives and property, the Constitution allows acts by way of exception. This implies that criteria regarding need and urgency override legal criteria that regulate the usual institutional activities (Vote 9410, Constitutional Chamber).

    c. The exception mechanisms regimen encompasses administrative activity and the designation of funds and public resources, so long as they are strictly necessary for the solution of commanding personal needs and for the protection of property and services at a time of and unequivocal connection between the event that provokes the state of emergency and the damages provoked thereof. (art. 32)

    d. Under the declaration of an emergency, all agencies, public institutions and local governments are obliged to coordinate with the Commission, which will have sole command over activities in the affected areas.

       The general emergency plan developed by the Commission must have priority over the plan of each institution that affects it, until the Executive Branch declares an end to the state of emergency. (art. 33)

    e. In order to execute actions, projects and contracts, the Commission will appoint as executive units public institutions with power over the area where they are active, as long as they have the necessary structure to fulfill commitments; the Commission as well as the executive units will be obliged to develop investment plans with details regarding the actions, projects and financial resources to be employed to address assigned roles, which should be approved by the Governing Board of the Commission. (art. 39).

f. The Commission has exclusive jurisdiction over the administration of National Emergency Fund resources which it will use to address and deal with emergency situations, according to the declaration and in conformity with the general emergency plan and the investment plans approved by the Governing Board of the Commission.

g) In conformity with stipulations regarding compliance with jurisdiction and responsibilities assigned to the Commission as contained in article No. 18 of the Law, it is within the purview of the Governing Board of the Commission to approve the procedures regulating the administration and use of National Emergency Fund resources.

THEREFORE:

In conformity with the above, the Governing board of the National Commission for Risk Prevention and Attention to Emergencies decides:

A. To create SPECIFIC BY-LAWS REGARDING PURCHASING AND CONTRACTS PROCEDURES UNDER EXCEPTION MECHANISMS REGIMEN BY VIRTUE OF THE DECLARATION OF A STATE OF EMERGENCY BY VIRTUE OF DECREE NO. 36440, which will be governed by the following articles:

Regarding procedures for the Authorization of Contracts:

1. Once a public institution is designated the Executive Unit in conformity with a specific decision for that purpose, the governing Board of the Commission can authorize the purchasing entity of the designated public institution to take responsibility for contracting procedures for the purpose of executing the actions and projects contained in the corresponding investment plan presented by the public institution.

2. It is the responsibility of the Commission's Purchasing and Contracts division to advise in the implementation of the Exceptions Mechanisms Regimen and the corresponding norms that will govern the said regimen.
3. Oversight of procedures and contract compliance are the responsibility of the comptroller department of the Executive Units.

Regarding Contract Procedures:

4. Prior to initiation of contract implementation the Executive Unit must sign a Letter of Intention based on the stipulations of the Executive Unit's by-laws and on necessary considerations for this special procedure.

5. In conformity with stipulations of the By-laws on Functions and Oversight of the Executive Units, all contracts for goods and services requiring executive units shall be undertaken in strict compliance with stipulations of the National Law on Emergencies and Risk Prevention, its by-laws and the By-laws of the Purchasing and Contracts division of the CNE with the necessary considerations regarding contracting under the exceptions regimen, in complement to pertinent stipulations of the Administrative contracting Law and its By-laws.

6. Authority in order that the Executive Units carry out their contractual activity shall be exercised under the strict and exclusive application of the procedure described in article no. 39, as of section b) of the By-laws of the Commission's Purchasing and Contracts division regarding the role of the division in contracts executed as a result of the emergency.

7. Such authority does not include the purview over administration of National Emergency Fund resources, it is limited to execution of emergency contracting procedures in he framework of the Exceptions Mechanisms Regimen permitted by Law 8488. In this regard, prior to forwarding to the Executive Directorate investment plans to be presented to the Governing Board, it is the responsibility of the Commission through Executive Units comptroller departments to ensure garnering of the resources necessary to ultimately honor monetary commitments, when the Executive Unit requests them. These reserves ensure the budgetary content required to give effect to the recruitment process, as required by the Law on Administrative Contracting and its By-laws.

8. Payment procedures by the executive units shall be carried out in conformity with article no. 27 of the By-law on Functions and Oversight of Executive Units.

Final Stipulations:

9. The present By-laws govern contracts related to the execution of the General Emergency Plan developed on the basis of Decree No. 36440 which declares a state of emergency in the face of the violations of Costa rican sovereignty by Nicaragua, and regarding this particular situation, it suspend norms of inferior hierarchy.

10. The present By-laws shall be suspended and without effect once Decree No. 36440 is overruled.

11. Supplementary application of the By-laws for Purchasing and Contracts, Law on Administrative Contracting and its By-laws.

12. That which is not specifically governed by these By-laws shall be governed by the By-laws for the Functions on Purchasing and Contracts division of the CNE, as well as by the Law on Administrative Contracts and its By-laws.

13. These By-laws shall be in effect as of their publication.

Msc. Sigifredo Pérez Fernández, Administrative Director for Finances.
- One time. - O. C. No. 14772. - Request No. 49892. - C-173650. -
(IN2011074828).

Annex 13

Central American Court of Justice Case No. 12 06 12 2011
Decision of 21 June 2012

Corte Centroamericana de Justicia

Case No. 12-06-12-2011

CENTRAL AMERICAN COURT OF JUSTICE. Managua, Nicaragua. Central America. At four o'clock in the afternoon on the twenty-first day of June in the year two thousand and twelve. **HAVING REVIEWED** Case No. 12-06-12-2011 for entry of judgment in the complaint brought against the State of Costa Rica by the National Recycling Forum (FONARE) and Nicaraguan Foundation for Sustainable Development, represented by Attorney Rosario del Socorro Saenz Ruiz, for purported violations to the Community Law, Regional Integration Law and International Law against the environment and biodiversity in the zone where Costa Rica is building a road, based on Articles 12 and 35 of the Tegucigalpa Protocol and Article 22, subsection c), of the Convention on the Statute of the Court, and the amended complaint filed against the State of Costa Rica on the seventh day of December in the year two thousand and eleven, which was admitted by this Court, in accordance with the jurisdiction and authority conferred upon it by Articles 12 and 35 of the Tegucigalpa Protocol, and for safeguarding the rights created by the Protocol, especially the protection, respect and promotion of the human rights of the inhabitants of the Central American community, legal security, peaceful dispute settlement and good faith of the Member States enshrined in Article 4, subsections a), g), h) and i), of the aforesaid Protocol, which literally provides: "To respect the principles and rules of the Charters of the United Nations Organization (UN) and Organization of American States (OAS), and the Declarations issued at the Central American Presidential Summits since May of 1986", and taking into account Article 22, subsection c), of the Convention on the Statute of the Central American Court of Justice. The Court was composed as follows: President Carlos Guerra Gallardo, Vice-President Alejandro Gómez Vides, Judges Silvia Rosales Bolaños, Ricardo Acevedo Peralta, Francisco Darío Lobo Lara and Guillermo Pérez-Cadalso Arias. **WHEREAS I.** At three fifteen in the afternoon on the sixth day of December in the year two thousand and eleven, a complaint was lodged with the Secretariat-General of the Court against the State of Costa Rica, alleging that the construction of a road of approximately one hundred twenty (120) kilometers had commenced on a stretch of the land border next to the south bank of the lower course of the San Juan River, known as Wildlife Refuge, which in turn forms part of the San Juan

River-Nicaragua Biosphere Reserve, declared by the United Nations Education, Science and Culture Organization (UNESCO) on September fifteenth (15), two thousand and three (2003). The document crediting the legal capacity of Attorney Rosario del Socorro Saenz Ruiz and other documents were attached thereto (Pages 1 to 131). **WHEREAS II.** The plaintiff contends that the engineering work is being carried out without informing the population or publishing the environmental studies that Costa Rica is obligated to carry out not only because it is mandated by its national legislation, but to comply with the treaties signed by that country in the field of environment and natural resources. It is unknown whether these studies have indeed been carried out prior to the construction of the road. Such engineering work should have been consulted with Nicaragua, as provided in Article 5 of the Convention on Wetlands of International Importance, especially as Waterfowl Habitat (RAMSAR). It is inadmissible that these Central American purposes to unite conservation efforts among neighboring countries, such as the case of the Trifinio Plan, Gulf of Fonseca and others contemplated in the Central American Agreement on Biodiversity signed by the countries of the region, including SI A PAZ between Nicaragua and Costa Rica in 1992, have been contradicted, undervalued and, worst of all, ignored and violated by a country like Costa Rica, which prides itself and sells itself internationally as "a model of eco-environmental management within its borders" (Pages 3 and 4). **WHEREAS III.** Attorney Rosario del Socorro Saenz Ruiz requests in her bill of complaint that the Court declare that Costa Rica has violated treaties and agreements in the field of the environment and natural resources with the construction of the so many times cited road. These agreements are: 1. The Central American Agreement for Protection of the Environment (CCAD) and regulations thereof. 2. The Agreement for the Conservation of Biodiversity and Protection of Priority Wildlife Areas in Central America. 3. The Regional Agreement on Climate Change. 4. The Regional Agreement on Trans-Boundary Movement of Hazardous Wastes, Article 3, Adoption of Preventive Measures. 5. The Alliance for Sustainable Development of Central America. In addition to the aforesaid legal instruments, the plaintiff further contends that Costa Rica has also violated the principles contained in the Tegucigalpa Protocol to the Charter of the Organization of the Central American States and complementary instruments or acts derived from it, such as Article 3, subsection b), h), and i), Article 4, subsection h), Articles 5, 6, 12 and 35 of the aforesaid Protocol, as well as Articles 26 and 35 of the Protocol to the General Treaty on Central

American Economic Integration, known as Guatemala Protocol. Likewise, it has violated Article 14, subsection j), of the Law Regulating the Organization and Functioning of the Councils of Ministers of Sectorial and Inter-Sectorial Economic Integration; and 6. The Central American Social Integration Treaty, known as San Salvador Treaty, and petitioned the Court to declare that, as a result of the construction of the aforesaid road, that country has violated each and every one of the aforementioned provisions, in addition to others that shall be mentioned hereunder (Pages 7 to 17). **WHEREAS IV:** Based on Article 31 of the Convention on the Statute of the Court, and in light of the serious environmental situation and latent irreversibility of the consequences of the actions taken by Costa Rica against the environment and biodiversity in the zone where the road is being built, as a result of the violation of the aforesaid rules, agreements and instruments, the plaintiff further requests an on-site inspection by experts, together with the Court, to the place where the road is being built, in order to verify and confirm the facts laid out hereinabove, which are causing and could cause catastrophic ecological consequences that would have an impact on nature, the environment, biodiversity, wetlands, forests and diversity of flora and fauna species, as well as the ictiological resources of the San Juan de Nicaragua River, which could be condemned to extinction (Pages 17 and 18). **WHEREAS V:** Based on the foregoing, the plaintiff applies for the following preventive measures: 1. Suspension of the works until a sentence is handed down. 2. That things go back to the state in which they were. 3. That Costa Rica provides an environmental impact study and environmental management plan regarding the road construction (Page 18). **WHEREAS VI:** By virtue of an order issued by the Presidency of the Court at four thirty in the afternoon on the sixth day of December in the year two thousand and eleven, the respective file was ordered to be opened and made known to the Court for entry of judgment (Page 132). **WHEREAS VII:** At two in the afternoon on the seventh day of December in the year two thousand and eleven, the plaintiff lodged with the Secretariat-General of the Court a brief to amend the complaint, based on Articles 12 and 35 of the Tegucigalpa Protocol to the Charter of the Organization of Central American States (ODECA) (Pages 133-135). **WHEREAS VIII:** By virtue of a decision handed down at twelve hours on the nineteenth day of December in the year two thousand and eleven, the Court unanimously agreed by a vote as follows: 1. To admit the complaint and amended complaint filed against the State of Costa Rica by Attorney Rosario del Socorro Saenz Ruiz, acting as the legal representative of the organizations National Recycling Forum (FONARE) and Nicaraguan Foundation for Sustainable Development, who was duly granted legal intervention. 2. To summon the State of Costa Rica through the General Prosecutor of the Republic, the Honorable Ana Lorena Brenes Esquivel, in her capacity as legal representative of that State. 3. To make an on-site inspection to the place of the alleged affectations on Thursday, January twelfth (12), two thousand twelve (2012) to gain direct knowledge of the facts, summoning the Central American Commission for Environment and Development (CCAD) so that it may designate one or several specialized representatives to accompany the Central American Court of Justice to the place of the facts. 4. The measures ordered herein shall be communicated immediately to the plaintiff and defendant in the most expedient manner, as well as to the other Member States of the Central American Integration System (SICA) and its Secretary General. 5. The address for service of process has been designated. 6. As regards the preventive measures requested by the plaintiff, this Court shall rule in due course. 7. Notify. Notice was served to the parties. The State of Costa Rica was served through the Embassy of Costa Rica in Nicaragua and the SICA Member States and Secretary General by email (Pages 136-160). **WHEREAS IX:** As requested by the plaintiff, on January twelfth, two thousand twelve, the Central American Court of Justice en banc went to the place of the facts, accompanied by Licentiate Alba Margarita Salazar, representative of the Central American Commission for Environment and Development (CCAD), and the respective act of acknowledgement was made, which appears on the front and back of page one hundred sixty-one (161). **WHEREAS X:** By virtue of a decision entered at four thirty in the afternoon on January seventeenth, two thousand and twelve, the Court unanimously agreed as follows: 1. To admit the application for preventive measures, consisting of the immediate suspension of the construction of the aforesaid road that the Government of Costa Rica is building parallel to the south bank of the San Juan River, so that the situation does not become more serious, thus safeguarding the rights of each of the parties and preventing irreversible and irreparable damage. 2. The measures ordered shall be maintained until a final sentence is entered. 3. To ask the Central American Commission for Environment and Development (CCAD) to prepare a technical report, within ten days from the date of notice, regarding the potential consequences and impacts caused by the construction of the road on the environment in general, especially on the watershed of the San Juan River. 4. To recommend to the authorities of Costa Rica and Nicaragua to engage in a specific dialogue, within the framework of their bilateral relations, for ensuring protection of the natural resources and protected areas of the zone, achieving harmony among their peoples, nations and governments, and striving for the preservation of a firm and lasting peace in the Central American region, which is a fundamental objective of the integration process. 5. To immediately notify this decision to the plaintiff and defendant by the most expedient means, as well as to the other Member States of the Central American Integration System (SICA), its General Secretary, and the Central American Commission for Environment and Development (CCAD). The decision was duly served to the parties, SICA Member States and General Secretary, and Central American Commission for Environment and Development (CCAD). (Pages 162-182) **WHEREAS XI:** By way of a brief filed by Attorney Rosario del Socorro Saenz Ruiz at eleven ten in the morning on the twenty-third day of January in the year two thousand twelve, the means of proof identified in Pages 185 and 186 were proposed. **WHEREAS XII:** At eleven fifty in the morning on the twenty-third day of January in the year two thousand twelve, the Court decided, upon expiration of the time period granted to the defendant to answer the complaint, to commence the evidentiary period for twenty business days counted from the last notice (front and back of Page 187). **WHEREAS XIII:** At three ten in the afternoon on the first day of February in the year two thousand twelve, Attorney Rosario del Socorro Saenz Ruiz, in her capacity as the legal representative of the plaintiff, requested an extension to the evidentiary period (Pages 189 and 190). **WHEREAS XIV:** At twelve hours on the eighth day of February in the year two thousand twelve, the Court ruled to extend the evidentiary period for another thirty business days counted from the date of expiration of the aforesaid time period (Page 192). **WHEREAS XV:** At ten thirty in the morning on March twenty-eighth, two thousand twelve, Attorney Rosario del Socorro Saenz Ruiz filed a brief containing evidence of the damage caused to the bi-national and regional ecosystem by the construction of a road immediately parallel to the south bank of the San Juan River, attaching seven (7) books containing evidentiary documents (Pages 194-1156). **WHEREAS XVI:** By virtue of a decision issued at twelve hours on the nineteenth day of April in the year two thousand twelve, the Court closed the evidentiary period and remitted the file to the Presidency so that it designate a date and hour for a hearing (front and back of Page 1157). **WHEREAS XVII:** By virtue of an order issued by the Presidency at ten o'clock in the morning on the second day of May in the year two thousand twelve, the parties were summoned to a hearing at Universidad Católica Redemptoris Mater at ten o'clock in the morning on the tenth day of May in the year two thousand twelve, which was held with the sole presence of the plaintiff (Pages 1158-1160). **<u>WHEREAS XVIII</u>:** The plaintiff lodged a final brief with the Secretariat-General of the Court on May fifteenth, two thousand twelve, at two fifty in the afternoon, within the prescribed three-day time limit, and the sentence is left pending. (Pages 1166-1171) **<u>WHEREAS XIX</u>:** On June eighteen of this year, the Secretariat of the Court received a brief from the plaintiff, attaching a note from Licentiate Samuel Santos López, Minister for Foreign Affairs of Nicaragua, dated June thirteen of this year. (Pages 1172-1175) **<u>WHEREAS I</u>:** This sentence shall follow the following logical timetable: **<u>FIRST:</u>** The fundamentals of the compulsory jurisdiction and authority of the Central American Court of Justice shall be addressed in general and in the case at hand. **<u>SECOND:</u>** Some procedural aspects that the Court deems necessary to rule on shall be addressed. **<u>THIRD:</u>** A legal appraisal of the means of proof shall be made regarding the conduct of the State of Costa Rica with respect to the community and international legal instruments signed and ratified by that State, which create an obligation in terms of environmental protection. **<u>FOURTH:</u>** A final sentence shall be entered according to law. **<u>WHEREAS II:</u>** The State of Costa Rica is a party to the Tegucigalpa Protocol and one of the members of the Central American Integration System (SICA), in accordance with Article 1 of the aforesaid instrument. The State of Costa Rica signed the Tegucigalpa Protocol and followed the procedures for undertaking obligations established in Article 36, ratifying the Protocol in accordance with its respective constitutional procedure, which was approved by Law 7502 of May three, nineteen ninety-five, and ratified by Executive Decree 24408 dated June twelve, nineteen ninety-five, so the Tegucigalpa Protocol is a treaty that obliges the State of Costa Rica, inasmuch as it establishes the compulsory jurisdiction and authority of the Central American Court of Justice, which constitutes an international obligation for Costa Rica that is fully enforceable by all SICA State Parties, bodies, institutions and individuals, and in the case at hand, environmentalist organizations National Recycling Forum (FONARE) and Nicaraguan Foundation for Sustainable Development. **<u>WHEREAS III:</u>** The Tegucigalpa Protocol is "…*the constitutive framework of the Central American integration treaty, and therefore is the highest hierarchical and fundamental basis of any other Central American law, including treaties, conventions, protocols, agreements or other legally binding acts prior to or subsequent to* *the entry into force of the Tegucigalpa Protocol." (CCJ:* File No.3-4-95. See advisory opinion regarding the legal status of the Tegucigalpa Protocol in respect of previous legal instruments and subsequent acts (Page 9)). It should be underlined that the Central American Community is a community of law. This means that the States and institutions that comprise it are subject to the control of the legality of their actions. Based on the foregoing, the States, bodies, institutions and individuals within the community can resort to the Central American Court, as the guarantor of the application and interpretation of the community rules contained in the Tegucigalpa Protocol and complementary instruments and acts derived thereof. The SICA Constitutive Treaty established the general guidelines, attributions and functional powers of its bodies. It recognizes the existence of a Community of States, which differs from the States when considered individually. This implies that the bodies and institutions of the SICA have their own decision-making power and those decisions are compulsory for the States. Similar to the Constitutive Treaty and complementary treaties, community decisions are of immediate enforceability and compliance, even against the will of the obligated parties. This is what makes the Central American Integration System (SICA) a true community of law. Within this institutional legal order created by the States, the Central American Court of Justice has real and effective power, as the jurisdictional body of the Community of States and Community of Law, and its decisions are binding for the States, bodies and institutions of the Community and natural or legal persons, public or private. **WHEREAS IV:** It has been ruled that the jurisdiction of the Court, as a Community Court, is governed by the principle of attribution, which means that treaties and protocols establish the criteria for setting the community competence. From a purely doctrinal viewpoint, a distinction could be made between the generic or implicit competence *(numerus apertus)* contained in the constitutive instruments and the specific or explicit competence *(numerus clausus)* contained in the Convention on the Statute. *Generic or implied* competence is attributed in the Constitutive Treaty of the SICA, that is to say, the Tegucigalpa Protocol. For its part, *specific or explicit competence* is attributed in the Convention on the Statute of the Court. Specific competence is derived from the generic competence, and the generic jurisdiction is developed by the specific jurisdiction. The same protocol mandates that the specific attributions of the Court shall be regulated by the Statute, which in its preamble states: "... shall have broad and comprehensive jurisdiction and competence..." (Convention on the Statute of the

Court) In effect, it is so enshrined in Article 30 of the Statute, which states: *"According to the rules set forth above, the Court has the power to determine its jurisdiction in each particular case, interpreting treaties or conventions relevant to the matter in dispute, and applying the principles of Integration Law and International Law."* These provisions leave ample leeway to the Court to set its jurisdiction, taking into consideration and interpreting the criteria set for specific cases (Article 22 of the Statute). Pursuant to the jurisprudence of the Court, this *"numerus apertus"* criterion, which governs the Tegucigalpa Protocol, should prevail in case of doubt about the jurisdiction of the Tribunal. The jurisdiction and competence established in Articles 12 and 35, second paragraph, of the Tegucigalpa Protocol are not optional or elective nor require further acts after the ratification and deposit of the Tegucigalpa Protocol by the States Parties to become a perfect international obligation, which is fully enforceable by all the State Members of the SICA, its bodies, institutions and individuals. In the instant case, Article 3, paragraph b) of the Tegucigalpa Protocol gives the Court jurisdiction in matters of environmental protection by providing: *"b) Creating a new model of regional security based on a reasonable balance of forces, strengthening civilian power, overcoming extreme poverty, promoting sustainable development, protecting the environment, eradicating violence, corruption, terrorism, drug-trafficking, and trafficking in weapons."* ***(Emphasis added).*** **WHEREAS V:** By signing, ratifying and depositing the Tegucigalpa Protocol, Costa Rica committed to submit to the Central American Court of Justice disputes on the application or interpretation of the provisions of the Protocol and its complementary instruments and derivatives. This requirement stems from the second paragraph of Article 35, which mandates that disputes arising in the future ***"shall be submitted"*** to this ***Court.*** **(Emphasis added).** The negotiators of the Tegucigalpa Protocol could have written that provision in a conditional tense: "should". However, they drafted the article in future tense: "shall". They also used the verb "do" which, according to the dictionary of the Spanish language of the Spanish Royal Academy, means: "To be obliged to something by divine, natural or positive law." The negotiators of the Tegucigalpa Protocol could have used another verb to indicate the capacity to do something, for example, the verb "do" in future tense: “may” However, both in its original version, signed by the Presidents of Central America, including His Excellency Rafael Angel Calderon Fournier, President of the Republic of Costa Rica, on December 13, 1991, and eleven years later, in the Amendment to the Protocol signed by the Presidents of Central America on February 27, 2002, including His Excellency Miguel

Angel Rodriguez, President of the Republic of Costa Rica, Article 35 was drafted using the verb "do" in the sense of a perfect community obligation. **WHEREAS VI:** The State of Costa Rica has performed acts that recognize the jurisdiction and authority of the Central American Court of Justice, which prevent this State from claiming any legal basis for not recognizing them. Public International Law attaches particular importance to the behavior of the States and assigns legal effect to acts of conduct in their international relations. The so-called "unilateral act" that the United Nations International Law Commission has defined in its third report as: *"...an expression of the unequivocal will of a State with the intent of producing legal effects in its relations with one or more States or one or more international organizations, and which is known by that State or international organization."*(Third Report, Op. Cit. 13, No. 80) In other words, such acts are *"...the expression of the irrevocable will of a State, which by itself, without need of the acceptance of another subject of public international law, and independently from any existing legal act, creates international rights and obligations for the issuing State and the right of any other subject of Public International Law to invoke in his favor or benefit the effects of that expression of will."* (Toro Jimenez, Fermin. Manual de Derecho Internacional Publico. 2 Vol. Universidad Central de Venezuela, 1982, Vol. I. Page 276, cited by Flores Perez, Edgard de Jesus. Los Actos de los Estados y la Regla del Estoppel, p. 97. www.iberopuebla.edu.mx/micro_sitios/.../**derecho**/.../ci_eflores.pdf). The Court's jurisprudence has recognized the legal effects of unilateral acts and estoppels (see judgment of the Court of 20 October 2009, Lawsuit filed by the Association of Costa Rica Customs Brokers against that State, File No. 6-8-9-2008 (WHEREAS XXI-XXIV, XXV and XXVI). In conclusion, according to these cited whereas clauses, the Court has reaffirmed its jurisdiction and authority, to which all Member States of the Central American Integration System are subject to. **WHEREAS VII:** The Central American Court of Justice has reiterated in its jurisprudence its Compulsory Jurisdiction, which applies to all those Member States of the Central American Integration System (SICA) which have not ratified the Statute of the Court in the following advisory and litigation cases: **Docket No. 01/01/1996.** Advisory Opinion of Dr. Raul Zaldivar Guzman, President of the Central American Parliament (PARLACEN). Decision dated 29 February 1996. **Docket No. 04/08/1996.** Application for Advisory Opinion of Mr. Jose Rodolfo Liekens Dougherty, Vice-President of the Central American Parliament (PARLACEN). Decision dated 13 December 1996. **Docket No. 1-30-4-2004.** Lawsuit filed by Dr. Juan Francisco Reyes

Wyld, Deputy to the Parliament (PARLACEN) against the State of Guatemala. Judgment dated 13 January 2005. **Docket No. 2-11-8-2006.** Lawsuit filed by Mr. Alfonso Portillo Cabrera, Former President of the Republic of Guatemala, against the State of Guatemala. Judgment of 5 May 2008. **Docket No. 6-8-9-2008.** Lawsuit filed by the Association of Customs Brokers of Costa Rica against that State. Judgment of 20 October 2009. **Docket No. 6-14-08-2009.** Request for Advisory Opinion of Oquelí Guadalupe Gloria Solórzano, President of the Central American Parliament **(PARLACEN).** Decision dated 23 September 2009. **Docket No. 1-18-02-2010.** Lawsuit filed by Mr. Javier Perez Pablo Gilberto Campos and Manuel Succari, Deputies from the Republic of Panama to the Central American Parliament (PARLACEN), against the State of Panama. Judgment of 20 October 2010. **Docket No. 02-26-03-2010.** Lawsuit filed by the Central American Parliament, through its President, Mr. Jacinto Suarez Espinoza, against the State of Panama. Judgment of 20 October 2010. **Docket No. 7-22-11-2010.** Lawsuit filed by Mr. Manuel Enrique Bermúdez Ruidíaz, Deputy to the Central American Parliament, against the State of Panama. Judgment of 22 February 2011. **WHEREAS VIII:** The State of Costa Rica was served notice at eleven forty-five on December twenty, two thousand eleven, by the Secretary General Ad Interim of the Central American Court of Justice, who went to the premises of the Costa Rican Embassy in the Republic of Nicaragua, and since the official notice of acceptance of the lawsuit filed by the National Recycling Forum (FONARE) and Nicaraguan Foundation for Sustainable Development against the State of Costa Rica was not received, proceeded to affix it in a conspicuous place at the premises of that embassy and read it aloud, thus producing the legal effects laid down in Articles 19 and 20 of the Code of Procedures of the Central American Court of Justice. **WHEREAS IX:** At the time that this lawsuit was admitted, this Court ordered protective measures to protect the rights of the parties, consisting of the following: *"To immediately suspend the construction of the road that the Government of Costa Rica is building parallel to the south bank of San Juan River, so that the situation does not escalate, thus protecting the rights of each of the parties and preventing the occurrence of irreversible and irreparable damage."* These protective measures were not respected by the State of Costa Rica, violating Article 39 of the Convention on the Statute of the Central American Court of Justice, which provides: " The interlocutory decisions, awards and final judgments of the Court are non-appealable and binding upon the States, specialized bodies of the Central American Integration System, and natural and legal persons, and shall be enforced like any decision, award and judgment by a national court of the respective State..." Based on the foregoing and the non-compliance of this decision, the juridical order of the Central American Integration System (SICA) was violated. The decisions issued by the Central American Court of Justice, including protective measures, are acts derived from the fundamental or complementary community law and as such are of ineludible compliance for the State Parties, SICA bodies and organizations, and individuals. The Court used as a basis the criterion of precaution to order protective measures, ordering Costa Rica to immediately suspend the construction of the road, in order to prevent "serious and irreversible damage" as provided in Article 15 of the Rio Declaration on the Environment and Development. Notwithstanding the foregoing, the reaction of Costa Rica was to ignore the measures ordered by the Court, incurring in contempt and disrespecting once again the Central American Community Law. **WHEREAS X:** Costa Rica and Nicaragua are bordering countries that form part of the Central American Community and Central American Integration System (SICA). They share a common basin and an ecosystem that comprises the San Juan de Nicaragua River and territories adjacent to their respective banks. According to Costa Rica, it is 2,000 meters wide along the border with Nicaragua and within its territory. In Nicaraguan territory, it comprises what is known as **Indio Maíz and Los Guatuzos Reserve** and nearby zones, which add up to more than 200 square kilometers. Next to this area are important wetlands shared by both countries. **WHEREAS XI:** This basin constitutes a true biological and environmental ecosystem, which has been recognized by the Programme on Man and the Biosphere of the United Nations Organization for Education, Science and Culture (UNESCO), which declared it **San Juan de Nicaragua River Biosphere Reserve** on September 15, 2003, and is an integral part of the World Biosphere Reserve Network. The main types of ecosystems and landscapes of our planet are represented in this Network, which is aimed to the conservation of biological diversity, scientific research and permanent observation, as well as to the definition of sustainable development models at the service of humanity. Likewise, other recognitions exist in this field through unilateral acts of the States. In Costa Rica, in Article 10 of Law No. 13, General Law on Idle Land, passed on 6 January 1939 and Article 7, paragraph F, of Law No. 22825, as amended, as well as Bilateral Conventions, Multilateral Treaties and Regional Community Law. Within the framework of this law, the San Juan River watershed forms part of the Central American Biological Corridor, created by Presidential Decree issued by the Government of Costa Rica on the thirteenth of October of nineteen ninety-four. **WHEREAS XII:** In terms of natural features, the San Juan River Wildlife Refuge is also very important. It is the youngest geological area of Central America, functioning as an evolutionary bridge for flora and fauna species in the continent. Its ecological importance lies in the diversity of ecosystems and habitats that it contains, forming part of one of the largest tropical humid ecosystems in Central America. The wetland plays a major hydrological role due to its location at the mouth of a very large watershed, which allows this refuge to capture a majority of the sediments and nutrients emanating from the two countries that share this watershed. Similarly, it acts as current regulator, flood controller and water pollutant subtraction. In this regard, Article 18 of the Regional Agreement for the Conservation of Biodiversity and Protection of Wildlife and Priority Areas in Central America refers to the basin as an **"International System of Protected Areas for Peace: SI A PAZ"**, which mandates to develop and strengthen, as a priority, protected areas in the land and coastal border zones. Consequently, with the construction of a road parallel to the south bank of the San Juan River, the State of Costa Rica failed to comply with the erga omnes obligations derived from the concept of Natural Heritage of Mankind, which is protected by Environmental Community Law and not only applies to Central America as a political and economic community that aspires to its integration, but to the International Community of States as a whole, inasmuch as the San Juan de Nicaragua River Biosphere Reserve belongs to the World Biosphere Reserve Network at the Service of Mankind, so the Member States of the Central American Integration System (SICA) are obligated to refrain from adopting unilateral measures that are contrary to the common created the International System of Protected Areas for Peace, **"SI A PAZ"**, Nicaragua and Costa Rica designated this basin as a protected area, and according to Article 9 of the Agreement for the Conservation of Biodiversity, *"it is a geographic area defined as terrestrial, coastal or marine, which is designated, regulated and managed to achieve certain conservation objectives, that is to say, a series of specific goods and services (on-site conservation)"*. This protected area comprises the channel of the San Juan River and adjacent areas on both bordering territories, thus creating a special ecosystem that is of course incorporated to the Central American Biological Corridor. According to Article 9 of the aforesaid Agreement for the Conservation of Biodiversity, ECOSYSTEM should be understood as: *"a complex of communities of plants, animals and* *microorganisms and non-living environment interacting as an ecological unit".* **WHEREAS XIV:** The Central American Integration System (SICA) has created a structure to protect the environment, consisting of provisions contained in institutional instruments, which make up the "Environment Subsystem", one of the four subsystems of the Integration Process, which rules are of compulsory compliance by the States that have ratified them: A) The Tegucigalpa Protocol is the primary and fundamental instrument of the System. In this respect, Article 3, subparagraph b), provides as follows: "Create a new regional security model, based on a reasonable balance of forces, strengthening civilian power, overcoming extreme poverty, promoting sustainable development, ***protecting the environment...*"** Subparagraph i) provides: "establish concerted actions aimed at the conservation of the environment, through respect for and in harmony with nature, ensuring a balanced development and rational exploitation of natural resources in the area, with a view towards establishing a new ecological order in the region." Article 4, subparagraph h), provides: "The good faith of the Member States in the performance of their obligations, refraining from establishing, agreeing on and adopting any measures that are contrary to the provisions of this instrument or hinder the compliance of the fundamental principles of the Central American Integration System or the achievement of its objectives." Article 6: "The Member States are obliged to refrain from adopting unilateral measures that may jeopardize the achievement of the purposes and compliance of the principles of the Central American Integration System"; (B) Articles 26 and 35 of the Guatemala Protocol to the Regional Integration Treaty; (C) Article 6, subparagraph f), and Article 8, subparagraph a) of the Social Integration Treaty or San Salvador Protocol; (D) Articles I and II of the Convention Establishing the Central American Commission on Environment and Development; Recital I of its Protocol and Article 3 of its Rules of Procedure; (E) Article 1, Article 2, subparagraph b), Article 10, Article 13, subparagraph g), and Article 18 of the Convention on the Conservation of Biodiversity and Protection of Priority Wildlife Areas in Central America; (F) Article 1, subparagraph c), of the Regional Convention for Management and Conservation of Natural Forest Ecosystems and Development of Forest Plantations; (G) Article 1, paragraph 2, of the Regional Agreement on Trans-boundary Movement of Hazardous Wastes; (H) Article 1 of the Regional Convention on the Climate Change; (I) General Objective 2 and Specific Objectives 3, 6 and 7 of the Alliance for Sustainable Development of Central America; (J) The preamble of the Tegucigalpa Declaration on

Peace and Development in Central America; (K) the Guacimo Presidential Declaration by way of which the Presidents recognize before the world: "...the unique and indivisible character of the Natural Heritage of Central America and assume the responsibility to preserve it"; (L) the Presidential Commitment in respect of environmental and natural resources in the Masaya volcano, Nicaragua. All of them signed and/or ratified by the State of Costa Rica and in force for all Signatory Parties of the system. **WHEREAS XV:** In addition to the obligations imposed by Community Law, Costa Rica and Nicaragua have signed and ratified important conventions in this field governed by public international law, which are directly related to the environmental strategy regulated by the Central American Community Law in the aforementioned documents, for example: The United Nations Conference on the Environment, Stockholm 1972; the United Nations World Charter for Nature of 28 July 1982; the Rio Declaration on Environment and Development of 1992; the Convention on Biological Diversity and the Convention Relating to the Wetlands of International Importance, Especially as Habitats for Water Fowl (RAMSAR), ratified by Costa Rica on the twenty-seventh of April of one thousand nine hundred and ninety-two. In the framework of this Convention, a consultancy report, precisely requested by the Government of Costa Rica on 15 and 22 November 2010, recommended, among other things, the following: "(a) due to its geographical location and dynamics closely linked to 1the wildlife refuge, the border corridor, and RAMSAR San Juan River Wildlife Refuge, the preservation of Northeast Caribbean Wetland requires a great effort of cooperation and collaboration within the two neighboring countries of both RAMSAR sites within the guidelines of the International Cooperation Convention." Consequently, individual States cannot allege that another State Party has not observed different rules or obligations of a same instrument as an excuse or pretext for not complying with the actions that are compulsory. (Underlining added). **WHEREAS XVI:** All these conventions signed by Costa Rica oblige the parties to consider the relevant precautionary measures before making unilateral or bilateral decisions that could have a strong impact on the conservation and maintenance of the environment they regulate. In this context, the provision of the Rio Declaration on Environment and Development, adopted in Rio de Janeiro on the fourteenth of June of nineteen ninety-two, in which both States are signatories, draws attention, which defines what is meant by **"dangerous activity",** which application should be especially meditated because it is an "activity involving the risk of causing significant damage in a particular area or zone". This Declaration stipulates "Principle 2...**the responsibility of ensuring that activities within their jurisdiction or control do not cause damage to the environment of other States or zones that are beyond the limits of national jurisdiction".** "Principle 10... including information on materials and activities that pose a danger in their communities." "Principle 15. In order to protect the environment, the States should broadly apply the criterion of precaution according to their capabilities. Where there are risks of serious or irreversible damage, lack of absolute scientific certainty shall not be used as a reason for postponing the adoption of effective measures based on costs to prevent the degradation of the environment". "Principle 17: An environment impact assessment shall be undertaken, as a national instrument, with respect to any proposed activity that could probably have a significant negative impact on the environment and that is subject to the decision of a competent national authority". "Principle 19: The States shall provide relevant information and prior timely notice to the States that might be affected by activities that may have significant trans-boundary adverse environmental effects and shall consult with those States at an early date and in good faith". (Emphasis added). **WHEREAS XVII:** The area in question is a fundamental part of the Mesoamerican Corridor, according to the agreement approved by the Central American Presidents on 12 July 1997, taking into account at the same time that the Government of Costa Rica has declared Natural Wildlife Refuge the border corridor formed by the land comprised along the border with Nicaragua, from Punta Castilla in the Caribbean Sea to Salinas Bay in the Pacific Ocean (MIRENEM Agreement Number 22962, which refers to the aforementioned Law No. 13 of January 6, 1939 and Law No. 22825 above). All of this leads us to conclude that it is actually a shared border river basin, which should be used and managed jointly, according to the above-mentioned regulations. **WHEREAS XVIII:** The fundamental principles that govern and organize the environment subsystem in the region are based on coordination, information and understanding between the parties, in order to harmonize their decisions on conservation measures that involve an obligation of the State Parties. **WHEREAS XIX:** The Convention Establishing the Central American Commission on Environment and Development (CCAD), which created the Central American Commission on Environment and Development, provides: "Regional cooperation should be a fundamental instrument in the resolution of ecological problems by reason of the deep interdependence between the countries of the isthmus and the regional organization of natural resources and the environment is a key factor for achieving lasting peace." In this order, Article 1 of the CCAD provides: the Contracting States establish a cooperation system for the timely and rational use of the natural resources of the area, pollution control and restoration of the ecological balance, to ensure a better quality of life for the people of the Central American isthmus. Article 2 contains, inter alia, the following objectives: a) "assessing and protecting the natural heritage of the region, characterized by its high biological and ecosystem quality"; b) "establish communication between the Central American countries in the search for and adoption of sustainable development styles with the participation of all bodies concerned for the development"; c) "promote the coordinated action of governmental, non-governmental and international organizations for the optimum use of the natural resources of the area, pollution control and restoration of the biological balance"; f) "promote the compatibility of the broad guidelines of national policies and legislation with the strategies for sustainable development in the region, particularly incorporating environmental considerations and parameters in national development planning processes"; g) "determine priority areas for action, among others: protection of common watersheds and ecosystems, tropical forest management, pollution control in urban centres... and other aspects of environmental deterioration that may affect the health and quality of life of the population." Article 3 of the CCAD regulations establishes that information is a social right which must be respected, so it should provide reports that are required by the Presidents of the States, the bodies of the Central American Integration System (SICA) and CCAD. Further, it should promote access to environmental information for social actors and other stakeholders". The Court finds that Costa Rica failed to comply with its obligation of communication with its neighboring counterpart Nicaragua, thus making it impossible to establish both the cooperation system between the States and the promotion of coordinated actions among governmental entities established by the Convention. (Underlining added). **WHEREAS XX:** The preamble to the aforementioned Conservation Agreement states that the Presidents: "sign it with the desire of protecting and preserving the natural regions of aesthetic interest, historical value and scientific importance that represent unique ecosystems of regional and global importance and have the potential of providing sustainable development options to our societies." The Conservation Agreement continues to affirm, take note, emphasize and highlight the importance: "of confronting with strong actions the preservation, rescue, restoration and rational use of our ecosystems, including endangered flora and fauna species". Article 2 limits the sovereignty of the State Parties in favour of respect to other States, particularly neighbouring countries, by providing: b) "ensuring that the activities within their jurisdiction or control do not cause damage to the biological diversity of their States or areas that limit their national jurisdiction". Article 10, for its part, provides: "Each Member State within this regional framework commits to take all possible measures, according to their capacities, national programmes and priorities, to ensure conservation of biodiversity and its sustainable use, as well as the development of its components within their national jurisdiction, and to cooperate to the extent possible in border and regional actions". Similarly, Article 13 tells us how the Conservation Agreement must be complied by the parties and the mechanisms they should adopt, establishing important obligations for the States, such as: "g) facilitating exchange of information between national institutions, between the countries of the Central American region and other international organizations." Specifically, in relation to the case at hand, Article 18 provides: Within this Agreement, border protected areas in the following land and coastal regions shall be developed and strengthened as a priority, citing, among others, the International System of Protected Areas for Peace, SI A PAZ, in which the ecosystem in question is found. (Emphasis and underlining added). **WHEREAS XXI:** Article 25 of the Conservation Agreement is of great importance when it mandates the States to ratify the international conventions that are obviously considered complementary to those of the Central American Integration System (SICA), to wit: International Convention on International Trade in Endangered Wild Fauna and Flora Species (CITES); Convention on the Conservation of Wetlands of International Importance and Habitats for Migratory Birds (RAMSAR) and UNESCO Convention for the Protection of the Natural and Cultural Heritage, providing that the States shall guarantee its internal compliance. Article 29 provides: "Appropriate procedures should be introduced in each of the countries of the region to evaluate the environmental impacts of the proposed development policies, programmes, projects and activities, in order to minimize them." Article 33 also reiterates: "Exchange of information on actions potentially harmful to the biological resources that could be developed in the territories within their jurisdiction should be promoted on the basis of reciprocity, in order to evaluate, among the affected countries, the most appropriate bilateral or regional measures". A fortiori, Article 37 underlines: "The provisions of this Convention shall not affect the rights and obligations of the Central American States arising from the existence of previous international conventions related to the conservation of biological resources and protected areas", which shows the great interaction and complementarity that exists between both groups of commitments in this area. (Emphasis and underlining added). **WHEREAS XXII:** The preamble of the Regional Convention for Management and Conservation of Natural Forest Ecosystems and Development of Forest Plantations reaffirms one of the purposes of the Tegucigalpa Protocol: "To establish concerted actions aimed at the preservation of the environment through respect for and harmony with nature, ensuring a balanced development and rational exploitation of the natural resources of the area, with a view to the establishment of a new ecological order in the region." Article 1 adds that the parties are obliged to: "c) ensure that activities within their jurisdiction or control do not cause damage to the environment of the country, or to other countries in the region". (Emphasis added). **WHEREAS XXIII:** The Court found that the legal nature of the Alliance for Sustainable Development (ALIDES), created by the Central American Ecological Summit for Sustainable Development, held in Managua, Nicaragua, on 12 October 1994, is an 'agreement' made by the Meeting of Presidents, which is the supreme body of the Central American Integration System (SICA), and within the same, in exercising the powers granted under Articles 14, 15, 30 and 31 of the said Protocol, it is legally binding for those States. (File No. 3-4-95, Request for Advisory Opinion regarding the situation legal of the Tegucigalpa Protocol with respect to previous legal instruments and subsequent acts, submitted by Dr. H. Roberto Herrera Cáceres, then Secretary General of the Central American Integration System (SICA), judgment of 24 May 1995). In its principles and objectives, ALIDES establishes the obligations of the parties relating to the sustainable management of natural resources and the improvement of environmental quality by imposing upon them, for example, the integrated sustainable management of the territories to ensure biodiversity in the region (Objective 3) and in the annex of specific objectives, Objective 7 compels them to "Properly manage the watersheds to ensure diverse uses of water resources in terms of quantity and quality." **WHEREAS XXIV:** At the International Conference on Peace and Development in Central America, held at Tegucigalpa on 24 October 1994, the Presidents committed to "stimulate a constructive dialogue between the governments, civil society, regional institutions and international community, for the purpose of broadly discussing the implementation of the commitments made within the framework of the Central American Alliance for Sustainable Development" (ALIDES). **WHEREAS XXV:** The commitments made by the Presidents of Central America in the field of environment and natural resources, at Masaya Volcano, Nicaragua, on 13 October 1994, by which the Central American Biological Corridor is created: "strengthening the National System of Protected Areas..." **WHEREAS XXVI:** This Court, at the request of the applicant and given the nature of the case, made on-site inspection at eight thirty five in the morning on the twelfth of January of two thousand twelve, which concluded at six thirty in the afternoon, in order to ascertain if there was any danger in the works concerning the road under construction that runs along the south bank of the San Juan River and, as a result thereof, took due note of the hazards and risks involved for the conservation of the ecosystem by the works initiated by the Government of Costa Rica. The Court has been able to verify the damage to the bank that protects the river on the south bank, especially in the many sectors where the road is dangerously close to the edge of the River, leaving it exposed to sedimentation by leaching, and also noted the lack of general buffering measures, such as culverts, drainages, etc. This Court highlights the fact that in many sections of the inspected area, the distance between the riverbed and the road is a few meters and the difference of level between the two is very pronounced, with the road in a dominant position and the river in a secondary position, all of which makes possible a landslide of large segments of the work in question, with the resulting sedimentation that would pollute the river. The Court also verified the felling of a large number of trees in Costa Rican territory, giving rise to vast areas where only reddish and clayish soil remains. **WHEREAS XXVII:** The Court estimates that it is **public knowledge, in view of the official statements made in the regional media by Costa Rican authorities, as well as an official statement of the Presidency of the Republic regarding "the posi**tion of the Government with regard to Route 1856" (which is the name with which Costa Rica identifies the road in question), published on Friday, 25 May 2012 on the webpage of the Ministry of Foreign Affairs and Worship of the Republic of Costa Rica, containing statements by the President of the Republic and opinions of technical and scientific authorities of the Costa Rican society, that the Government of that State made unilateral decisions, in a hasty manner and without consultation, in light of the Community Integration System, which affect the bilateral commitments of that Government with the neighbouring State of Nicaragua. In addition, these news of obvious notoriety, known by the majority of the Central American and international community, reveal the absence of environmental impact and mitigation studies by Costa Rica, which are essential for commencing works of this magnitude. Likewise, added to the case file on page 1173 is the affidavit of the Minister of Foreign Affairs of Nicaragua, Licentiate Samuel Santos López, expressing that the Ministry has not received any report or official communication from the Government of Costa Rica requesting a dialogue, mitigation measures or the beginning of a potential negotiation with the Government of Nicaragua in relation to the road it is building on the right bank of the San Juan River and that he has not received from official Costa Rican sources any environment impact study relating to this work. Consequently, this Court considers that Costa Rica was obliged to communicate to the Government of Nicaragua the characteristics, effects and environmental impact study of the construction of the road by virtue of its international and community commitments imposed by treaties, conventions, agreements and legislative acts derived from the Tegucigalpa Protocol in the field of environment protection. **WHEREAS XXVIII:** In relation to Decree No. 36440 issued by the Government of Costa Rica and published in the Official Journal of Costa Rica on Monday, March 7, 2011, which serves as a basis for the creation of the road in question, this Court reiterates the principle of international law, laid down in the Vienna Convention on the Law of Treaties, that nobody can alleged non-compliance of duly contracted international obligations, using as a pretext the provisions of its domestic legislation, whether ordinary or extraordinary. **THEREFORE: THE CENTRAL AMERICAN COURT OF JUSTICE, ON BEHALF OF CENTRAL AMERICA,** based on Articles 3, 4, 12 and 35 of the Tegucigalpa Protocol and Article 22, subparagraph c) of its Statute Convention, by **A UNANIMOUS VOTE, RULES: FIRST:** The State of Costa Rica is subject to the jurisdiction and authority of the Central American Court of Justice as a State Party of the Tegucigalpa Protocol to the Charter of the Organization of Central American States (ODECA) and for other reasons stated in this judgment. **SECOND:** The lawsuit brought by the National Recycling Forum (FONARE) and Nicaraguan Foundation for Sustainable Development against the State of Costa Rica is admitted as the claims made in this proceeding are duly based on the law. **THIRD**: The State of Costa Rica acted without consultation, in a unilateral, inappropriate and hasty manner, violating international bilateral and multilateral agreements validly contracted by building the road in question, which cannot be obviated by alleging internal provisions. **FOURTH:** The State of Costa Rica started the work in question without conducting the studies and previous analyses required in the context of the obligations imposed by Regional Community and International Law, ignoring collaboration, mutual understanding and communication between the State Parties of all these conventions that should exist in the field of environment and sustainable development. **FIFTH:** The State of Costa Rica built a high-risk and environmentally hazardous work, which it should have prevented within the framework of the community obligations because it exposes the common watershed and ecosystem shared with Nicaragua and the region to serious and unpredictable damage, which this Court was able to observe during its on-site inspection in the area in question. **SIXTH:** Consequently, the State of Costa Rica is condemned for having violated, inter alia, Articles 3, 4 and 6 of the Tegucigalpa Protocol, Articles 26 and 35 of the Guatemala Protocol, Articles 1, 2, subparagraphs a, b and g, of the CCAD, Article 3 of the CCAD regulations, Articles 2, 10, 13, 25, 29, 33 and 37 of the Convention for the Conservation of Biodiversity and Protection of Priority Wildlife Areas in Central America, Objectives 3 and 7 of the Alliance for the Sustainable Development of Central America (ALIDES), as well as the provisions of international conventions, such as RAMSAR (Article 5) and other treaties, conventions and agreements on the subject described in WHEREAS XIV and acts derived from the Tegucigalpa Protocol that form part of the regional community body of knowledge. **SEVENTH:** The State of Costa Rica is condemned for having incurred in liability for ecological and related damages to the San Juan de Nicaragua River, as well as to the shared ecosystem that forms part of the Central American Biological Corridor and to the respective basin. Further, to the common wildlife biodiversity that rotates and remains around the river and maintains the ecological balance of fauna, flora and the environment that the State of Costa Rica is obliged to respect and sustain as a Natural Heritage of Humanity. **EIGHTH:** The State of Costa Rica is condemned for incurring in contempt of court by not complying with the precautionary measures ordered by the Central American Court of Justice on January seventeen, two thousand twelve, and the order to definitively suspend the construction of this road is reaffirmed. **NINTH**: This Court refrains from determining the amount of damages claimed as redress for the liability incurred because the plaintiff did not provide the necessary elements to quantify the environmental damage caused. **TENTH:** Notify.

(Signed) Carlos A. Guerra G. (Signed) Alejandro Gomez V. (Signed) F. Dario Lobo. (Signed) R. Acevedo P., (Signed) Guillermo A. P. (Signed) Silvia Rosales B. (Signed) OGM.

Annex 14

Diplomatic Note from the Minister of Foreign Affairs
of Nicaragua, to the Minister of Foreign Affairs of Costa Rica,
Ref: MRE/DVM/AJST/500/11/11, Managua.

29 November 2011

Managua, 29 November 2011

MRE/DVM/AJST/500/11/11

Mr. Minister:

I have the honor to address you on the occasion of referring to aspects of the construction of a 120 kilometer road (approximately) which your Government is developing in the area between Boca San Carlos and the Delta.

This road runs parallel to, and is a short distance from, the San Juan River of Nicaragua and drains into the river. Besides destroying the flora and fauna of a very extensive zone of common wetlands as a result of these activities, there is also the dumping of the residue resulting from land removal and other forms of residue into our San Juan River.

These projects have been covered extensively by the press in your country. The 17 October 2011 edition of Costa Rica's **Diario La Nación** points out that "The Government is constructing a 120 kilometer road parallel to the border with Nicaragua, in order to avoid the use of the San Juan River by the population and the Police for their travel". The article further states that the route will extend to the area which was determined by the International Court of Justice as an area in dispute by its 8 March 2011 order.

Also, the authorities of your country have confirmed the advanced stage of the project. In statements to Costa Rican newspaper, **La Prensa Libre**, The Minister for Public Security, Mr. Mario Zamora Cordera, revealed that the road parallel to the Río San Juan will be completed in December 2011.

The Government of Nicaragua reminds the Government of Costa Rica that a project of this nature should have an Environmental Impact Assessment due to their characteristics. Further, this assessment should have been sent to the Government of Nicaragua due to the proximity to Nicaragua of this project and in conformity to International Law and the International Court of Justice 8 March 2011 Order and Article 5 of the RAMSAR Convention, which stipulates that " The Contracting Parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavour to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna".

In this regard, the National Reconciliation and Unity Government of the Republic of Nicaragua can only qualify this construction project as contrary to the cited norms of International Law as well as paragraph 86, number (3) of the abovementioned International Court of Justice Order.

Because of the above the Government of Nicaragua demands the immediate suspension of these projects until their environmental impact can be assesed.

Mr. Minister, I extend the assurances of my distinguished consideration.

Manuel Coronel Kautz
Minister by Law

To H.E.Enrique Castillo Barrantes
Minister of Foreign Affairs
Republic of Costa Rica

Annex 15

Diplomatic 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

The Minister for Foreign Relations and Cult

29 November 2011

DM-AM-601-11

His Excellency Mr. Minister:

I extend my greeting to your Excellency on the occasion of referring to statements of high level authorities of the Government of Nicaragua. According to these statements a road being constructed by Costa Rica in an area on the common border with Nicaragua will supposedly cause environmental damage to Nicaraguan territory.

In relation to this issue, the Government of Nicaragua knows very well that the reasons Costa Rica has been obliged to develop this infrastructure project are related to Nicaragua's activities in the border area.

At the same time, Costa Rica considers that the project mentioned is not affecting Nicaraguan territory. Nonetheless, in the spirit of a good neighbor policy and environmental protection, as well as in compliance with pertinent agreements on this matter, the Government of Costa Rica is willing to hear Nicaragua's concerns regarding the construction of this road.

In this regard, my Government invites the Government of Nicaragua to present formally the reasons for which it considers that there may be environmental damage or damage to Nicaragua's interests. For this purpose, Costa Rica requests to receive serious and objective scientific information that proves Nicaragua's allegation. In the same spirit, my country expects the same attitude from the Government of Nicaragua regarding projects that may affect Costa Rican territory.

Finally and also in the context of the facilitation process led by the Governments of Guatemala and Mexico, Costa Rica is in the best disposition to accept the participation of both States in the discussion and analysis of common environmental issues.

Mr. Minister, please receive the assurances of my consideration.

/s/ [seal]
Enrique Castillo Barrantes

H.E.Samuel Santos López
Minister of Foreign Affairs
Republic of Nicaragua

[Stamped:]
Nicaragua Embassy
San José, Costa Rica
Office of the Ambassador
29/11/11, 10
Received by: /s/ [illegible]

Annex 16

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, Managua.

10 December 2011

MINISTRY OF FOREIGN AFFAIRS

Managua, 10th December 2011

MRE/DVS/VJW/0685/12/11

Dear Mr. Minister:

The National Reconciliation and Unity Government regrets to communicate that, in relation to your note DM-AM-601-11 dated 29th November 2011, considers inappropriate and inadmissible to request Nicaragua to point out the damages that may result from the project that your government is constructing in the right bank of the San Juan of Nicaragua River.

The Government of Nicaragua considers that such expression is the result of a wrong interpretation of the obligation of your distinguished government to present to Nicaragua, prior to the commencement of the road, the Environmental Impact Assessment and the Environmental Management Plan, both of them being a fundamental requisite to carry out a project of such a magnitude.

Trying to invert the logic in regard to the obligations of Costa Rica implies not assuming the commitments with mother nature, International Law and the bilateral and multilateral Conventions and Treaties that your government has subscribe in defense of the environment and biodiversity, among which we can mention the Regional Convention for the Management and Conservation of the Natural Forest Ecosystems and the development of forest plantations signed in Guatemala on 29th October 1993, Stockholm Declaration, Rio Declaration, Agenda 21 and the February 2, 1971 Convention on Wetlands of International Importance especially as Waterfowl Habitat (RAMSAR), whose Article 5 was highlighted in paragraph 79 of the Order of the International Court of Justice dated March 8 2011: "*Article 5.- The contracting parties shall consult with each other about implementing obligations arising from the Convention especially in the case of a wetland extending over the territories of more than one Contracting Party or where a water system is shared by Contracting Parties. They shall at the same time endeavor to coordinate and support present and future policies and regulations concerning the conservation of wetlands and their flora and fauna*".

The government of Costa Rica far from informing its own people and Nicaragua about the project, has kept them hidden. Furthermore, high ranking people of the government have made misleading statements in the media by affirming that the project had been ceased.

Independently of the above mentioned, 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, difficulting 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.

I point out that the above list does not exhausts all the consequences and responsibilities of Costa Rica related to the execution of this project, including the incursions in Nicaraguan territory and the violations of the demarcation monuments.

The obligation of Costa Rica to inform Nicaragua about the Environmental Impact Assessment prior to the commencement of the project cannot be reinstated by calling upon facilitators. Nicaragua cannot accept anything less than the ceasing of the project until it has had the chance to receive and analyze the Environmental Impact Assessment on the project.

I take this opportunity to express the assurances of my consideration.

His Excellency Enrique Castillo
Minister of Foreign Affairs and Cult
Republic of Costa Rica

Seal
Embassy of Costa Rica
Managua, Nicaragua
Date: 10/12/2011
Time: 7:05 pm
Received by: Edwin Arias

Annex 17

Diplomatic note from the Minister of Foreign Affairs and Worship of Costa Rica to the Minister of Foreign Affairs of Nicaragua, Reference DVM-AM-286-11

20 December 2011

Seal of the Republic of Costa Rica

The Deputy Minister of Foreign Affairs and Cult

December 20, 2011
DVM-AM-286-11

Honorable Minister:

I greet Your Excellency on occasion of referring to notes MRE/DVM/AJST/500/11/14 dated November 29 and MRE/DVS/VJW0685/12/11 dated December 10, both of the current year.

In reference to both notes, the Government of Costa Rica rejects the affirmations that construction of a dirt road in the northern area of Costa Rica "severely affects the environment and the rights of Nicaragua". The alleged "consequences" of this work, enumerated by the Government of Nicaragua, is in no way evidence that it caused damages to Nicaragua, and it therefore rejects the alleged protest. Costa Rica is still waiting for Nicaragua to contribute strong evidence as to the location of the irreversible damages caused to the San Juan River alleged by Nicaragua.

It is contradictory that Nicaragua should demand from Costa Rica the "presentation to Nicaragua prior to beginning road construction, of the Environmental Impact Study and the Environmental Management Plan". Nicaragua itself has systematically refuses to provide information to Costa Rica and to submit the corresponding studies for all of the works that it develops in the border area, including dredging of the San Juan River. These works also include stream cutting and deviation of the natural riverbed. Allow me to remind Nicaragua that it continues dredging works in the San Juan River, which according to Nicaragua's own studies, suppose the removal of more than three million cubic meters of sediment. All of these sediments currently dumped in the San Juan River Wildlife Refuge wetlands, a Ramsar Convention Site, in addition to the sediments already dumped in the North Caribbean Wetlands of Costa Rica, also a Ramsar Site.

Likewise, I recall that Nicaragua has also built an airport with an extension of two kilometers directly in the same San Juan River Wildlife Refuge Wetlands, in an area adjacent to Costa Rican territory and the San Juan del Norte Bay, joint property with Costa Rica. Nicaragua did not fulfill its international obligation to serve notice to the Secretariat of the Ramsar Convention, much less to inform Costa Rica, about either of the works, neither dredging with the subsequent dumping of sediments into the wetlands or the airport construction.

Nicaragua also builds a large-scale bridge in the San Juan River and announced construction of a dam that in the words of President Ortega himself will have devastating effects for the environment in the region. Costa Rica neither received notice about any type of studies for these works.

The purpose of the works carried out by Costa Rica, under the protection of a National Emergency Decree, is to safeguard the integrity of its territory and bring development to that area of the country. These works, undertaken with minimum possible impacts, are a consequence of the serious actions that Nicaragua made and continues to make in the borderline area. This includes the continuous defilement of the Ruling that Dictates Interim Measures issued by the International Court of Justice on March 8, 2011, by sponsoring the constant presence of members of the Sandinista Youth Organization in Costa Rican territory in the northern sector of Portillos Island, known as Aragon Farm. All of the above, without mentioning the devastation of several hectares of primary forest, as well as construction of an artificial canal in the North Caribbean Wetlands, in Costa Rican Territory.

Despite evidence that the reasons that move Nicaragua to launch the aggressive campaign against Costa Rica are not environmental; nevertheless, Costa Rica maintains its willingness to listen to any legitimate concern with due backup. In this sense, and given that Nicaragua alleges that this could cause damages to the San Juan River, Costa Rica requests immediate remittance of the existing studies about such river. Costa Rica especially request 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, and detect any possible affectations.

Lastly, and given its relation with the Nicaraguan policy to disavow the established boundaries and threatening Costa Rican national security, the Government of Costa Rica avails itself of this occasion to introduce its most energetic protest for the events that took place yesterday, Monday December 29. Given that, a group of about 15 Nicaraguan soldiers penetrated approximately on kilometer into Costa Rican territory in the Punta Castilla sector, uttering threats against officials of the Costa Rican Public Forces in the area. This documented event is an unacceptable violation of Costa Rican sovereignty. This confirms that Costa Rica has sufficient reasons to take measures provided by international law to protect its national territory, as well as those civil works that ensure protection of its territorial integrity. It also includes those civil works that ensure full exercise of its territorial sovereignty and monitor actions carried out by foreign forces in our country. Allow us to demonstrate those violations before the respective international organizations.

Receive, Honorable Minister, the assurances of my consideration

Illegible Signature,
Carlos A. Rovers Rojas,
Deputy Minister

Stamped Seal: Ministry of Foreign Affairs
Office of the Deputy Minister
San Jose, Costa Rica
Excellency

Mr. Samuel Santos Lopez
Minister of Foreign Affairs
Republic of Nicaragua
English: NCM

Annex 18

Note from the Minister of Environment and Natural Resources of Nicaragua (MARENA) to the United Nations Environmental Program (UNEP), Ref: DM-JAS-1397.12.11.

10 December 2011

Office of the Minister

Managua, 10 December 2011

Ref DM-JAS-1397.12.11

Mrs. Margarita Astralaga

Regional Director

United Nations Environmental Program

(At her Office)

Dear Mrs. Astralaga:

In the context of UNEP's objectives of leading and encouraging participation in environmental protection and taking into account that biodiversity conservation is one of the most important themes in which the UNEP collaborates with other countries, and that at present Nicaragua is doing studies in order that it be declared a mega-diverse country, we feel obligated to inform you of the damages and current threats to our natural patrimony in the Biosphere Reserve of the Rio San Juan as a result of the construction by Costa Rica of a 130 km long road parallel to the San Juan River. The removal of forests and the immediate vegetation to the river flow, among others, has caused the interruption of the interrelationship of the ecosystem and biological corridors, and has endangered the existing fragile biodiversity.

Costa Rica began and continues to construct this parallel road despite its tremendous direct and immediate environmental impact caused upon our Río San Juan Biosphere Reserve, thus disregarding its international obligations of notifying Nicaragua of its intent to pursue a project of this magnitude, especially as it impacts on an area under national, regional and international protection. Further, Costa Rica has also violated its obligation to carry out a trans- boundary environmental impact assessment and to transmit this to us for analysis and comments.

This attitude is contrary to international norms, including the Stockholm Declaration, the Río Declaration, Agenda 21, Principles on Forests, RAMSAR, and especially, the Convention on Biological Diversity which expressly requires notification projects and environmental impact evaluations, especially when these would have important adverse effects on the biological diversity of another State.

In the same manner, we would like to take this opportunity to also inform you that we have also proceeded to notify UNESCO [of this matter] since it relates to a Biosphere Reserve recognized by that entity. We have also informed the RAMSAR Secretariat since this relates to wetlands recognized under this convention.

As regards all of the above, I would like to request your collaboration and support, within the framework of UNEP activities, a study be carried out which would allow determination of the environmental impact as a result of the project mentioned and which would facilitate decision-making regarding this situation.

In the hope of a prompt response given the urgency of this case, in gratitude for your attention to this and in reiterating the assurances of my consideration and esteem, I remain,

Cordially,

/S/ [Sealed]
Juanita Argeñal
MARENA Minister

cc:
Mr. Nazario Expósito
UNOPS Representative in Nicaragua
Samuel Santos/ Minister of Foreign Affairs of Nicaragua
Mr. Pablo Mandeville
UNDP Representative in Nicaragua

Annex 19

Note from the Minister of Environment and Natural Resources of Nicaragua (MARENA) to UNESCO, REF: DM-JAS/1393.12.11.

10 December 2011

Office of the Minister
Managua, 10 December 2011
Ref: DM-JAS/1393.12.11

Doctor
Juan Bautista Arrién
Representantive of UNESCO
United Nations Educational, Scientific and Cultural Organization
Dear Doctor Arríen:

As you know, on 15 September 2003 the Biosphere Reserve of the Río San Juan was designated as such, and it is conformed of a system of protected marine and terrestrial areas, biological reserves, natural reserves and a wetland system, where the interrelation of Man and the Biosphere it´s a reality for the coastal population, particularly for the indigenous communities.

Aware of our historical duty with humanity for being depositories of such patrimony, we regret to inform you of the damages and current threats to our natural patrimony in the Biosphere Reserve of the Rio San Juan as a result of the construction by Costa Rica of a 130 km long road parallel to the San Juan River. The removal of forests and the immediate vegetation to the river flow, among others, has caused the interruption of the interrelationship of the ecosystem and biological corridors, and has endangered the existing fragile biodiversity.

Costa Rica began and continues to construct this parallel road despite its tremendous direct and immediate environmental impact caused upon our Río San Juan Biosphere Reserve, thus disregarding its international obligations of notifying Nicaragua of its intent to pursue a project of this magnitude, especially as it impacts on an area under national, regional and international protection. Further, Costa Rica has also violated its obligation to carry out a trans- boundary environmental impact assessment and to transmit this to us for analysis and comments.

Bearing in mind UNESCO´s objectives, we invoke Costa Rica´s obligation to respect the Convention concerning the protection of the World Cultural and Natural Heritage, which establishes the obligation "**not to take any deliberate measures which might damage directly or indirectly the cultural and natural heritage referred to in Articles 1 and 2 situated on the territory of other States Parties to this Convention**"

The extensive and singular biodiversity that exists in the Biosphere Reserve of the Río San Juan is the reason itself for having been recognized by UNESCO, and given the circumstances, we invite you to visit the place and confirm the grave ecological damage that has been caused and that, evidently, will continue to be caused if the works are not immediately ceased.

I am looking forward to hear from you promptly. I take this opportunity to thank you and reaffirm the assurances of my highest consideration.

Fraternally,

Juanita Argeñal Sandoval
Minister MARENA

Cc: Samuel Santos/ Minister of Foreign Affairs of Nicaragua
Roberto Araquistain/Viceminister of the Environment

Annex 20

Note from the Minister of Environment and Natural Resources of Nicaragua (MARENA) to the Secretary General, RAMSAR Convention, REF:DM.JAS.1350.11.11.

28 November 2011

Office of the Minister

REF:DM.JAS.1350.11.11

Managua, 28 November 2011

Mr. ANADA TIÉGA
Secretary General
RAMSAR Convention
[To his office]

Honorable Mr. Secretary General:

Please receive our cordial greeting for 2011, The Year of Unity for the Common Wellbeing and Protection Forests.

The Government of Nicaragua take this opportunity to reiterate its environmental policy; to develops and reconstruct the human values of care and love for our Mother Earth; in its conservation of its wetlands, in the implementation of biodiversity conventions and RAMSAR.

In compliance with international environmental protection norms and our commitment to Mother Earth, the National Unity and Reconstruction Government of Nicaragua informs the following to the RAMSAR Convention:

The Government of Nicaragua has observed with great concern a construction by the Government of Costa Rica of a road, approximately 120 kilometers in length, which runs parallel and very close to the San Juan River of Nicaragua and drains into the river. Besides destruction of the flora and fauna of a very extensive common wetlands zone, the residue resulting from the removal of land and other matter have been dumped in our River. Intensive deforestation and land movement on the riverbank of our river may be observed in the attached photograph which was published in the 27 November 2011 edition of El **Nuevo Diario**, a Nicaraguan newspaper.

According to information published in different Costa Rican media, the said construction is only part of a series of projects announced by the government of President Laura Chinchilla in December 2010, including the opening of a road parallel to the San Juan River of Nicaragua of more than 120 kilometers in length, the construction of heliports and a pedestrian bridge over the Colorado River for access to Harbour Head, the installation of sewers and even a pier in the Colorado River, as well as the construction of nets to serve as the openings in the Colorado, San Carlos and Sarapiquí Rivers.

These projects, which are mere meters away from Nicaragua's San Juan River and destroy extensive shared wetland zones, violate the norms of International Law that regulate relations between States; and regarding the RAMSAR Convention they violate, among others, the commitments of the sister nation of Costa Rica of holding consultations on compliance of its obligations derived from said Convention and its duty to actively coordinate and support present and future policies and regulations relative to the conservation of wetlands and their flora and fauna, related to wetlands and the hydrologic system shared with our country.

Given the clear violations of its obligations regarding environmental protection, given the seriousness of the situation and the imminent threat of irreparable environmental damage, given the lack of cooperation regarding conservation of biodiversity and management of hydrologic resources, our country requests the Convention to immediately send an Advisory Mission to visit the zone and verify on the ground the flagrant violations of the RAMSAR Convention by this sister nation, which put the wetlands in the Nicaraguan and Costa Rican side at high risk. As a result of the foregoing, we also request that the Government of Costa Rica be required to provide all the complete technical information necessary for the evaluating and drawing conclusions regarding the present state of the zone and that these be sent to our country to facilitate present and future policies and regulations for the conservation of our shared hydrologic and wetlands system.

With nothing further to address, I remain yours,

Fraternally,

JUANA ARGEÑAL SANDOVAL
Minister, Ministry for the Environment and Natural Resources

Annex 21

Note from the Minister of Environment and Natural Resources of Nicaragua (MARENA) to the Central American Commission on Environment and Development (CCAD), REF: DM-JAS-1398.12.11.

10 December 2011

Office of the Minister
Managua, 10 December 2011
Ref. DMS-JAS-1398.12.11

Mr. Hernán Rosa
Minister of the Environment
of El Salvador
Protempore Presidency of CCAD (by its Spanish acronym)
To His Office

Dear Mr. Rosa:

The National Reconciliation and Unity Government of Nicaragua, presided by Commander Daniel Ortega Saavedra, has declared that it is a priority to protect, defend and restore our natural patrimony through a national human development plan which puts forth the policies and strategies in this regard, in particular, the national strategy for the environment in the face of climate change, and its system of environmental impact evaluation in order to anticipate possible impact by developments, projects, programs.

At present, Nicaragua has 71 protected areas, three biosphere reserves, nine RAMSAR sites, three national parks, and natural biological and genetic reserves. Outstanding among these is our Río San Juan Biosphere Reserve, which is consists of a wetlands system extending from San Miguelito to the Los Guatuzos Wildlife Reserve, five protected areas and a Natural Biological Reserve at Río Indio Maíz.

All of this natural patrimony is presently threatened by the varies impact of the construction project of the Government of Costa Rica of a more than 130 kilometer road parallel to Río San Juan of Nicaragua. Deforestation, removal of vegetation, sedimentation, and other factors, are damaging these fragile nationally, regionally and internationally protected ecosystems.

Costa Rica began and continues to construct this parallel road despite its tremendous direct and immediate environmental impact caused upon our Río San Juan Biosphere Reserve, thus disregarding its international obligations of notifying Nicaragua of its intent to pursue a project of this magnitude, especially as it impacts on an area under national, regional and international protection. Further, Costa Rica has also violated its obligation to carry out a trans- boundary environmental impact assessment and to transmit this to us for analysis and comments.

The above mentioned is contrary to a series of international and regional norms, including the Constitutional Convention of the Central American Environment and Development Commission which we subscribe "Conscious that regional cooperation should constitute a fundamental tool … due to the profound interdependency between the countries of the isthmus"; it is also contrary to the Regional Convention for the management and conservation of natural forest ecosystems and forest development, the Convention for the conservation of the biodiversity and protection of the main wild life sites in Central America, the Agreement over the Protected Areas between Nicaragua and Costa Rica.

Based on all of the above, I would like to request that the pertinent regional mechanisms be activated to allow, among other things, the swift on site damage verification, analysis and study of the situation at the technical and political levels, and any other measure towards the immediate suspension of these Costa Rican works until there is a trans-boundary environmental impact assessment and until we have had an opportunity to study such evaluation.

It is important to point out that Nicaragua has encouraged dialogue among the countries of the isthmus in order that we may clarify the differences, resolve them and move forward together as brother countries, and our President Cdr. Daniel Ortega S., on several occasions has called on the Government of Costa Rica in order that we seek consensus and allow harmony to rein to the benefit of our Mother Earth.

With the hope of a prompt response from you, and grateful for your attention to this matter, I reiterate the assurances of my consideration and esteem.

Fraternally,
/S/ [Sealed]
Ms. Juanita Argeñal Sandoval
MARENA Minister

cc:
All Central American Ministers for the Environment
Comrade Samuel Santos, Foreign Minister of the Republic of Nicaragua

Annex 22

University Seminar, Costa Rica "Environmental damage feared due to construction of highway parallel to Río San Juan"

1 November 2011

Environmental damage feared due to construction of highway parallel to

Río San Juan

Tuesday, 1 November 2011, 23:43

By Ernesto Ramírez (eramag2002@yahoo.com)

University Seminar

Environmentalists and persons involved in natural resources protection fear that the highway being constructed by the Government parallel to the Río San Juan will have a serious environmental impact and that in the end the "medicine will be worse than the illness."

The highway, planned by President Laura Chinchilla's administration in the context of the border conflict with Nicaragua, affects the area's ecology and a large area characterized by biodiversity considered "strategic" and of enormous importance by environmental advocates.

Development of the project is based on an emergency decree (36440) issued by Chinchilla last 21 February and published in the official daily "La Gaceta" on 7 March.

This decree allows several Government entities, including the Transportation Ministry and the National Highway Safety Council, to operate under exception, which allows them to override permit procedures and other regulations.

Have profound environmental impact studies been done regarding the San Juan zone highway? Is Costa Rica really facing an emergency when in March the Court in The Hague issued precautionary measures and Nicaraguan troops abandoned territory of the Caleros-Los Portillos island long ago? How much awareness is there regarding the impact of this route in a zone of enormous environmental importance such as the bi national basin of the San Juan?

This and another series of questions are of concern to several ecologists and environmental advocates who do not hide their fear that the highway will cause serious damage to protected systems in the zone and will, in the context of the conflict that broke out in October of last year, in fact give Nicaragua arms against Costa Rica.

(See separate item: MINAET [Spanish acronym] vigilant against serious impact, said the Deputy Minister.)

According to geologist, Allan Astorga, any project similar to the one promoted for the border with Nicaragua involves environmental risks. He stated to UNIVERSIDAD that for this reason "it should be developed and implemented under an effective environmentally minded procedure in order to avoid damage."

Environmental lawyer and Costa Riva UNIVERSITY professor, Álvaro Sagot, also expressed concern regarding the project since it is unknown if it is guided by the concepts of environmental viability.

"It is very simple. The necessary Environmental Impact Studies are being passed over by way of a decree. No one can say that there is or will not be any environmental impact regarding biodiversity," he commented.

Nicolás Boeglin, an international law expert recalled that the San Juan region has biological corridors that are protected by law.

"From the ecological standpoint, this is a vulnerable zone. Certain precautionary measures have to be taken in the construction of a highway," he indicated.

The vice-president of the Environment Court, Yamileth Mata, admitted that she was even unaware of the construction of the highway. She did not discard eventual intervention by the body regarding the viability of the project.

On the other hand, Uriel Juárez, Secretary General of the National Environmental Technical Secretariat (SETENA, by its Spanish acronym), told UNIVERSITY that this body has not been consulted, nor have its criteria on the highway and its possible risks been requested.

"There has been no request or inquiry regarding criteria here," he indicated.

The director of the Tortuguero Conservation Area, Luis Rojas, said that that entity of the SINAC (Spanish acronym) "participated in some instances of consultation" regarding about 30 kilometers under its jurisdiction. He commented to this weekly that "Every project involves risks."

Miguel Zamora, assistant director of the Arenal-Huetar Norte Conservation Area, reported that this entity in carrying out an "routine investigation" to verify what is happening in his area. "We have not been consulted on this project," he assured.

Mauricio Álvarez, of the Environmental Booths of the University of Costa Rica, as well as Gino Biamonte, director of the ecology group APREFLOFAS, also expressed his fear. Separately they both stated, "The area is too sensitive and vulnerable."

Legislator Claudio Monge of the Citizens Action Party (PAC, by its Spanish acronym) warned, "We are investigating, I will not allow an environmental disaster."

MINAET is watchful against serious impact

Environment, Energy and Telecommunications Vice Minister, Lorena Guevara, said that entity is watchful in order that the environmental balance of the San Juan zone not be affected. Below are parts of her answers to questions sent to her by e-mail.

How was MINAET involved in supervision of the project since it is located in protected corridors?

The decree referred to responds to a "particular or *sui generis*" emergency, since it was issued in the middle of the situation and process caused by the Nicaraguan violation of Costa Rica's sovereignty, particular in Calero island, and because of the environmental damage caused in our homeland.

Due consideration should be given to the particular nature of the event that led to the decree and the General Emergency Plan developed to address it. This was essentially a political phenomenon with many effects and variants that are difficult to pinpoint. Under these circumstances, the constitutional system provides special rules that allow the Executive Branch to address emergency situations, so that action can be as prompt and decisive as the circumstances merit thus minimizing the consequences of natural and other disasters.

Was the risk and environmental impact of this project evaluated?

In the present situation and given latent threat of further incursions from Nicaragua, Costa Rica must design vigilance mechanisms and ensure permanent presence of its police forces in the conflict zone at the southernmost part of the Colorado Delta, and the border side of the Río San Juan. Phase One of the General Emergency Plan includes concrete action by seven institutions: the Ministry for Public Security, the Costa Rican Electrical Energy Institute, the National Risk Prevention and Emergency Commission, the Costa Rican Red Cross, the Costa Rican Social Security Fund, the Environment Energy and Telecommunications Ministry, and the National Highway Commission. Activity of the CONAVI (Spanish acronym) includes the construction of an artery parallel to the Río San Juan, and in the case of the MINAET-National System for Reserve Arjeas, these entities have the role of constant environmental monitoring and surveillance over national wildlife reserves in the region.

Which is the supervising entity? Why wasn't the SETENA included? Who did the environmental impact studies, if there were any?

In the case of the MINAET, the intention is to provide the SINAC with the necessary conditions and resources for protection and surveillance. The MINAET-SINAC has been careful that the projects cause as little environmental impact as possible, since the primary purpose of the road parallel to the Río San Juan is to safeguard life and physical integrity, property and the environment in the face of disasters and dangerous events that may occur. The other entities have been accountable and have proceeded in compliance with the regulations regarding an extraordinary situation provided by a decree of this nature. As a member of the National Emergencies Commission, the MINAET has been informed of the actions resulting from this emergency decree, and at a technical level the SINAC has been responsible for the actions established in the General Emergency Plan. It should be mentioned the route parallel to the Río San Juan was established along the two kilometer wide northern border strip where human activity has been evident for many years.

Annex 23

Diario Extra, Costa Rica “Nicaragua Request Studies
on the Soberania Road”

13 December 2011

In environmental impact evaluation

NICARAGUA REQUESTS STUDIES ON THE SOBERANIA ROAD

Nicaragua's Deputy Foreign Minister, Valdrak Jaentschke, sent a note to Costa Rican Foreign Minister Enrique Castillo, requesting that he furnish environmental impact reports regarding construction of the Soberanía Road which unites border towns and serves as a alternative trade route in order that the towns avoid Nicaragua's Río San Juan.

According to the Deputy Foreign Minister, it is evident that the Soberanía Road causes erosion of adjacent slopes which in turn causes sedimentation of the San Juan River. This affects the dredging project and navigation, and also alters the ecological balance of species for which the river serves as a natural habitat.

He stated that Managua will not accept anything other than paralysation of the construction which is taking place on Costa Rican soil. He went further stating in a communiqué of the Nicaraguan Foreign Ministry that in its construction Costa Rica has entered *pinolero* territory and altered border markers.

Enrique Castillo had previously stated, "We have no reason to report to Nicaragua on our projects within Costa Rican territory. We have nothing to converse with the Nicaraguans as long as they continue to send people to Calero Island, which violates preliminary measures mandated by the Court in The Hague."

Annex 24

El País, Costa Rica "Chinchilla defends highway criticized by Nicaragua, rejects dialogue"

14 December 2011
(Source: EFE / 13 December 2011)

El País.cr

Wednesday, 14 December 2011 – Costa Rica

Chinchilla defends highway criticized by Nicaragua, rejects dialogue

Source: EFE / 13 December 2011

San José, 13 Dec (EFE) – The president of Costa Rica, Laura Chinchilla, said today that her country the right and the need to construct a highway on territory near the border with Nicaragua. She rejected dialogue with that nation which has criticized the project due to alleged environmental damage.

Everything we are doing is according to the law. We issued and emergency decree due to national necessity and it is on that basis that we have developed the projects. We are not taking even one step back," express Chinchilla today in the press conference following the weekly meeting with her cabinet.

The 120 kilometer highway is being constructed on Costa Rican territory. It connects 20 communities near the Río San Juan, under Nicaraguan sovereignty, which runs along the border and was the only communication channel between the settlements.

"Our only action has been to bring development to a northern border population which can now enjoy communication through Costa Rica territory," said Chinchilla.

The president emphasized that the dwellers themselves donated land from cattle ranches to facilitate construction of the highway. She ensured that the communities have also benefitted from newly acquired electrical service, running water and schools, as well as the creation of some 7,000 jobs.

In recent weeks, the Nicaraguan Government has complained to Costa Rica for supposed environmental damage to the Río San Juan provoked by the highway and has demanded that the project be detained until environmental impact studies are revealed.

Nonetheless, Chinchilla reiterated that her country has the right to construct the project with no explanation to Nicaragua and dismissed the idea of serious environmental damage. She ensured that there is a mitigation plan as is the case with any "national project".

"We have no reason to offer explanations to the Government of Nicaragua," said the president.

Chinchilla recalled that Nicaragua "has paid no mind" to the precautionary measures mandated by the International Court of Justice (ICJ) in a case regarding Nicaragua's supposed invasion of a piece of Costa Rican territory near the Río San Juan where is supposedly caused environmental damage to wetlands protected by international conventions.

"There will be no dialogue until Nicaragua complies with instructions issued by the Court," said Chinchilla.

The ICJ ordered both countries to abstain from deploying civilian, military or police personal to the zone in controversy, but in recent months Costa Rica has denounced the constant presence there of members of the "Sandinista youth."

According to the Nicaraguan Government the Sandinista youth have gone there for environmental protection tasks.

On 5 December Costa Rica presented the ICJ in The Hague, an aide memoire with initial written allegations against Nicaragua regarding the territorial dispute.

Annex 25

El Nuevo Diario, Nicaragua "Outrage everywhere over San Juan River parallel highway, No Studies Done for Costa Rican Highway"

15 December 2011

El Nuevo Diario

15 December 2011

Outrage everywhere over San Juan River parallel highway

No Studies Done for Costa Rican Highway

*Costa Rican Foreign Foreign Minister Confesses: “Emergency Decree” exempted Costa Rica from environmental impact study on the project

José Adán Silva and Sixto Valladares

[National News Section]

A statement by the Nicaraguan Academy for Geography and History on the ecological disaster caused by Costa Rica in the Río San Juan as a result of its construction of a highway parallel to the waterway calls on the Government of Nicaragua and international environmental protection organizations to sue the Government of San José for this action, which according to the organization, is being carried out out of revenge and resentment, and out of disregard for the Nicraguan and Central American ecosystem.

The statement by the prestigious cultural and scientific institution of the country points out that the construction of this highway Laura Chinchilla’s government is reflecting “disregard for world concern for the conservation of tropical rain forests, reflects unfortunate resentment toward Nicaragua and discredits Costa Rica as a green country.”

The statement by the Academy consists of five points in which it denounces on the world level and draws attention in Central America, regarding the damage to nature on the istmus caused by the destructive Costa Rican projects at a time when the region is most vulnerable in the face of the climate change due to environmental destruction.

An attack on Central America

According the statement, “The cross-border impact of this near fet acompli is an attack against Central American natural patrimony. In this regard, Nicaragua should resort to the International Court of Justice for precautionary measures directed to mitigating the ravages caused to the present, and to suspension of the mentioned construction.”

This 120 kilometer highway does not contribute to the progress of the almost non-existent Costa Rican Caribbean population, but rather alters the ecosystem created by the river and its basin and prevents Costa Ricans’ practice of eco-tourism through their exercise of their right to limited navigation along the mentioned stretch of the lower course of the Río San Juan. In fact residue dumped into the river will destroy one of the few waterways of the continent (by finishing off its fauna among other irreparable damage) and compromises the navigability of the Río Colorado, a tributary of the Río San Juan located on Costa Rican territory,” added the Academy.

Developing this highway violates all bilateral, regional and international conventions and treaties signed by the two countries for the promotion of responsibility for environmental protection, and which prohibit dumping sediment and other pollutants into a neighboring country.

Finally, Costa Rica has disregarded Nicaragua's claim that a country cannot destroy the environment of a neighboring country as this constitutes an unfriendly and irrational attitude," pointed out the Nicaraguan Academy for Geography and History.

"There are no environmental impact studies"

As if ratifying the "unfriendly and irrational attitude," the Costa Rican Foreign Minister himself, Enrique Castillo, confessed yesterday to the Costa Rican press that the environmental demolition work was not the subject of environmental impact studies because they were carried out in the context of an emergency decree that "exempted" them from these requirements.

True to their incendiary and nationalist rhetoric, the Costa Rican Foreign Minister reiterated that his country is not obligated to any kind of explanation, "nor to suspend its work being carried out as a consequence of an emergency provoked by Nicaragua, because we are being invaded by 500 Nicaraguan army soldiers disguised as ecology monitors that work along the border."

"Nicaragua has not presented an environmental impact assessment on the Brito project, on the construction of an airport that is already completed in the wetlands zone protected by RAMSAR to the north of our border, or on its invasion of Isla Portillos (Harbour Head), on its dredging which whereby residue has been dumped on Costa Rican territory," he expressed.

This is a sovereign project we are carrying out under a decree that exempts us from environmental impact studies, that is why we owe no explanations," confessed the official thus revealing that behind these projects there is no study for mitigating environmental damage in the zone. We still do not know who will represent Costa Rica in the SICA summit, said Castillo.

And when will the lawsuit be presented?

According to former Nicaraguan foreign minister, Norman Caldera, the government of president Daniel Ortega should request precautionary measures before the International Court of Justice in order to stop environmental demolition while experts jointly request bilateral dialogue to which has been adamantly opposed by Costa Rica.

The government should have acted long ago and requested precautionary measures to detain these projects. It should have filed a lawsuit long ago. This is not a matter of issuing Notes to an entity that is outright disinterested in dialogue. What is the matter with the government that it has not acted?" Caldera asked.

Religious, environmental, indigenous and community, political, civil society and business voices have joined this demand that Nicaragua act more firmly and decisively to stop the environmental degradation. According to former diplomat Julio Icaza the main problem is that “neither of the two presidents has the will or the political maturity”.

To each his role

Icaza is of the opinion that the conflict which begun last year should have been discussed bilaterally “for the good of both nations.”

However, since that time the high level officials from both countries have committed countless errors “in that there has been no capacity for a serious dignified dialogue toward imaginative solutions in the management of this rich and promising border area.”

Icaza said that each government is using the conflict over the Río San Juan for benefit through so-called patriotic speeches and rousing nationalist sentiment. “He is absorbed in the accumulation of power and uses nationalism to obtain more of it; she seeks to use the conflict to distract from her ineffectiveness and the lack of popularity her government has come to. While they maintain these positions there will be no progress,” according to Icaza.

Insistence on dialogue

“This problem will be resolved there are mature government with vision, led by true statesmen with a vision for the future and enough will to resolve the conflict and not for using it for solving internal problems,” said Icaza.

Mario Herdocia, an international relations expert agrees, “The best instrument is dialogue between Costa Rica and Nicaragua. There has a been a vacuum in the bilateral relation in that these two neighbors and brothers must learn to solve their differences through dialogue and negotiation.

According to Herdocia the dialogue is “the opportunity for Costa Rica to present the environmental impact assessment and for Nicaragua to present its concerns so they may come to an agreement.

Muscle and rhetoric

The former ambassador to Costa Rica, Mauricio Díaz indicated that even though “to the present they have not come to the boiling point,” the tension has precluded the possibility of a solving the conflict through bilateral dialogue.

“Ortega has been all rhetoric and Mrs. Laura’s reaction has been more muscle than brains. She is endangering Costa Rican eco-democracy,” according to his observation while alerting that regardless of the discourses behind the Costa Rican projects lie true social concerns for both riverbanks of the waterway, for the potential damage to the ecosystem as a result of the project underway.

Not 120 kilometers but 160

Official information on the projects made public yesterday in San José by the President of Costa Rica, indicate that the highway in reality consists of 160 kilometers and extends from the Costa Rica Delta to the village of Los Chiles. This includes reparation to 300 additional kilometers of accesses to the main highway in order to "connect" 2,500 families living the area.

In Nicaragua the issue has generated total opposition from environmental groups that are taking legal and court action to sue the Chinchilla government: they are doing studies, they are on site filming, taking notes, gathering testimony and other carry out other activity relevant to their competence.

The Ministry for the Environment updated information on the environmental destruction for the Central American Integration System (SICA, by its Spanish acronym), the UNESCO, the Central American Court and the United Nations System for the Environment.

(Matilde Córdova and María Adelia Sandoval collaborated with this article.)

Annex 26

La Prensa, Nicaragua “Surroundings Damage Could not be hidden”

14 January 2012.

Surroundings
DAMAGE COULD NOT BE HIDDEN

- Damage and threat are evident despite hiding slopes and drainages.

Wilder Pérez R.

For Costa Rica, hiding ecological threat to the Biosphere Reserve of Nicaragua's San Juan River was like hiding an elephant behind a bamboo: it is impossible to do even by Criss Angel, the world's most famous magician.

The six CCJ judges travelled to Nicaragua's San Juan River to determine if evidence substantiates de complaint in order to forward with the trial against the Costa Rican Government requested by two Nicaraguan environmental organizations for damage and latent threats to nearby ecosystems as a result of the 160 kilometre road being constructed by San José along the riverbank.

Although Francisco Darío Lobo, CCJ president, affirmed they will not issue an evaluation until next Tuesday, his private comments and initiatives reveal what was evident: real ecological damages had been wrought on the zone.

ANIMAL MIGRATION

The full court, with two Honduran, two Salvadoran, and two Nicaraguan members, was surprised by the wilderness on the Nicaraguan side of the riverbank. It is impenetrable, crocodiles freely take sun, birds are on tree branches hanging over the river, suddenly fish jump over the water, waters are green and plants grow on top of one another with exuberant flowers and stems – there is no fear of humans.

The judges spoke with enchantment of nature in Nicaragua, although it is not related to the trial, they were dumbfounded by the landscape at the point where the border with Costa Rica reaches the southern border of the river.

Most of the slopes, with 90 degree angles, were covered with black and green synthetic fabric covering the orange earth below the vegetation.

Two hundred drainage pipes, previously visible, were hidden with earth, twigs and dry tree trunks they themselves had cut in order that the judges not see the pipes.

There are stretches where they are still burning the flora in order to then eliminate it.

Further, the first landslides were observed, their earth draining thickly and slowly from Costa Rica into Nicaragua's San Juan River.

Damage caused by the Costa Rican road is evident. The local population even speaks of a great feline creature, a jaguar that crossed the river seeking refuge in Nicaragua. But the economy does not escape. River shrimp abandoned their home, and at present can only be caught at the mouth of the San Juan River. According to fishermen and merchants, this caused its price to increase from 80 to 120 *cordovas*, and sales decreased by 70 per cent. According to local merchants, almost the same has happened in the tourism sector and tourists make faces when they see the road.

Annex 27

La Prensa, Nicaragua “Costa Rica’s difficulties due to road construction”

16 January 2012

Costa Rica's difficulties due to road construction

- The self-proclaimed "environmental country" faces a week of environmental trials

The Government of Costa Rica has until tomorrow, Tuesday, to speak out to Central American and its own judiciary bodies on environmental damage to its territory and to Nicaragua's San Juan River. LA PRENSA/M. ESQUIVEL.

By Wilder Pérez R.

As of today, Costa Rica could have a bad week if the Central American Court of Justice (CCJ, by its Spanish acronym) decides to go ahead with a judgment against the San José Government for causing serious damage to ecosystems of Nicaragua's San Juan River. Meanwhile, the Constitutional Division of Costa Rica's Supreme Court of Justice will hear those similarly affected in another judicial process.

Further, Costa Rican Foreign Minister Enrique Castillo was ordered by the CCJ to present proof that that judicial body is partial to Nicaragua as he stated.

Costa Rica decided to replant the deforested zone near the 160 kilometre road it is constructing parallel to the river, an action that according to Nicaraguan environmentalists is a desperate move to hide the harm caused near a biosphere reserve.

Will a sheet of green or black fabric bring back the fauna of Nicaragua's San Juan River after construction by Costa Rica of a road parallel to the river? Was chopping the branches of trees necessary for a horizontal project? Does Nicaragua have to be the depository of Costa Rica's chemical waste? Why was the UN's precautionary principle ignored? These questions and others will have to answered by President Laura

Chinchilla's officials in her country and this week these questions may also be asked by the CCJ.

UP TO ITS NECK

When Laura Chinchilla's Government appears before the Central American Court of Justice and the Supreme Court o Justice it will already have a nebulous history against nature.

At least eight ministers, high officials and mayors from Costa Rica were called to a trial opened against them by the Let Me Live in Peace World Foundation and the Progress for the Blind Foundation.

Bolivian President Evo Morales was forced to detain construction of a road in TIPNIS due to damage similar to that being caused in a San Juan natural reserve.

Two hundred drainages along the road being build by Costa Rica along the San Juan River were clogged in order that members of the CCJ could not observer Laura Chinchilla's decision of putting sediment and garbage into the waters of the Nicaraguan waterway.

All this occurred several days after Laura Chinchilla's Government had land and vertical slopes displaced along the contested path hidden with supposed synthetic fabric, although she denied damage to the zone.

But far from hiding its actions, these actions made environmentalists and Nicaraguan authorities more suspicious regarding environmental damage by Costa Rica in the area of the waterway.

If the CCJ initiates the process Costa Rica could become the first isthmus country to be prosecuted for environmental crimes against humanity.

If Castillo presents no proof, the CCJ judges could accuse him legally. The Government of Costa Rica could be declared in contempt and ordered to stop the project by its own Court if it does not provide the studies requested by it.

Annex 28

El Nuevo Diario, Nicaragua "Central American Parliament supports CCJ decision on environmental damage by Costa Rica"

27 February 2012

Central American Parliament supports CCJ decision on environmental damage by Costa Rica

Calls for bilateral dialogue between Nicaragua and Costa Rica in the presence of Mexico and Guatemala as Friends of the Court

By Miguel Carranza | National News

Daniel Ortega Reyes and Orlando Tardencilla, parliamentarian and vice president of the Central American Parliament and vice president of the Education Commission of the body, respectively.
MIGUEL MOLINA / END

The Central American Parliament (Parlacen by its Spanish acronym) adopted a resolution supporting the Central American Court of Justice (CCJ by its Spanish acronym). The resolution calls on members of the Central American Integration System (SICA by its Spanish acronym) and Costa Rica in particular, to respect the decision of the CCJ regarding construction of the Costa Rican road that is causing environmental damage to Nicaragua's San Juan River.

The resolution was read by Daniel Ortega Reyes, a member and vice president of the Central American Parliament, and Orlando Tardencilla, vice president of the Education Commission of the body.

The Parlacen proposed exhausting dialogue between the nations "in order to find a harmonious and Central American solution to the conflict over the San Juan River in conformity with the CCJ decision.

Further, it calls on President Daniel Ortega and his Costa Rican counterpart, Laura Chinchilla, to reinitiate bilateral dialogue in the presence of Mexico and Guatemala as Friends of the Court.

Annex 29

La Prensa, Nicaragua "Central American Parliament urges Costa Rica to respect environmental security in the San Juan River"

27 February 2012

Central American Parliament urges Costa Rica to respect environmental security in the San Juan River

AFP

The Central American Parliament (Parlacen by its Spanish acronym) representatives today reported that the body has urged Costa Rica to put an end to its environmental damage to Nicaragua's San Juan River in compliance with the precautionary orders of two international courts. The Central American Parliament (Parlacen by its Spanish acronym) representatives also stated support for the 17 January decision of the Central American Court of Justice (CCJ but its Spanish acronym) ordering Costa Rica to suspend construction of a 160 kilometre road parallel to the river after a case brought due to environmental damage by Nicaraguan ecology groups.

The resolution adopted by the forum on Thursday in Guatemala indicates that the Parlacen demands "respect" of stipulations" by the CCJ that call for guaranteeing "preservation" of the border river's "environment". Costa Rica is not a member of the CCJ.

The Parlacen document shares Nicaragua's concern regarding the "grave damage" that thousands of tons of mud and construction residue" are causing the river. Costa Rica is part of the Central American Integration System and the CCJ, but has never ratified either's constitutional statutes, thus, it denies the standing of these bodies to mediate in this conflict with Nicaragua.

The parliamentarians maintain that the two countries should at least reinitiate bilateral dialogue "with the support of the Governments of Guatemala and Mexico" in order to avoid "dramatic and continuous harm to the river".

In its resolution, the Parlacen also supports precautionary measures of the International Court of Justice (ICJ) adopted in March 2011 for protection of the border zone in the framework of a claim by Costa Rica against Nicaragua over a tiny river island situated east of their common border.

Annex 30

La Prensa, Nicaragua "San Jose should respect the river"

28 February 2012

SAN JOSE SHOULD RESPECT THE RIVER

Central American Parliament calls for care of the San Juan River

Despite graphic evidence, Costa Rica denies damage being caused by its road at the edge of the San Juan River.

The Central American Parliament (Parlacen by its Spanish acronym) representatives today reported that the body has urged Costa Rica to put an end to its environmental damage to Nicaragua's San Juan River in compliance with the precautionary orders of two international courts. The Central American Parliament (Parlacen by its Spanish acronym) representatives also stated support for the 17 January decision of the Central American Court of Justice (CCJ but its Spanish acronym) ordering Costa Rica to suspend construction of a 160 kilometre road parallel to the river after a case brought due to environmental damage by Nicaraguan ecology groups.

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The Parlacen document shares Nicaragua's concern regarding the "grave damage" that thousands of tons of mud and construction residue" are causing the river.

"Decisions of the Central American Court of Justice are binding"

Although Costa Rica has ignored the Court and accused it of distorting the conflict with its partiality toward Managua, the Parlacen stated that resolutions of the

Central American Court of Justice regarding the border conflict between Nicaragua and Costa Rica are binding.

Further, the Parlacen stated that it would transmit its resolutions to the presidents and Foreign Ministers of the region as well as to the Central American Integration System and European delegations.

Costa Rica is a member of the Central American Integration System, which created Parlacen, however it never ratified the constitutional statutes of either organism and thus denies their standing for mediation in the conflict with Nicaragua.

Annex 31

La Nación, Costa Rica "Conavi Built a Dirt Road along the Border without a Single Design Plan"

23 May 2012

160 KM CONSTRUCTION WORK PARALLEL TO THE SAN JUAN RIVER LACKED DESIGN

Conavi Built a Dirt Road along the Border without a Single Design Plan

Lack of design plans might have raised costs and cause accelerated deterioration of the road

Government did not anticipate drainage systems nor did it perform a topographic survey to find the best layout

ESTEBAN OVIEDO eoviedo@nacion.com **12:00 A.M.** 23/05/2012

Conavi built a 160-kilometer dirt road along the border with Nicaragua, without a single design plan to evidence the layout for opening the road or to determine the characteristics it should have.

RELATED NOTES

Absence of design might end up in higher costs, environmental problems and fast deterioration of the project, stated Olman Vargas, Executive Director of the Federated School of Engineers and Architects (CFIA).

The construction work lacked a topographic survey to define the route with the least amount of obstacles. In addition, ditches, culverts or river crossings not designed. Now, as the National Roadway Council (Conavi for its acronym in Spanish) itself admitted, the dirt road has many slopes with gradients greater than those due and curves not apt for proper vehicle transit.

The inexistence of design plans confirmed to this news media by CFIA, Conavi and the company, Compañía Asesora de Construcción e Ingenieria SA (Cacisa for its acronym in Spanish). The latter hired in January of the current year to provide project supervision support.

The dirt road construction began in December 2010, in the wake of the conflict that arose with Nicaragua in October of that same year over the occupation Calero Island.

Conavi spent a bit over ¢20.000 million in the Project, which includes habilitation of 440 km in access roads.

Nine hundred (900) machines - Fourteen months after works began, when Cacisa joined the work efforts, it found 900 machines working along the border without any design plans.

Roberto Cambronero, an engineer from Cacisa, described it like this: "We arrived at a cutting drawer, a cut on both sides (of the dirt road). Then we asked the person in charge, how much before finishing? What are you doing? 'Oh, I'm cutting'. Moreover, how much do you still have to do? He did not know because there were no design plans, and you can perfectly well say, 'leave it here'".

José Manuel Sáenz, Cacisa partner, added that a design would allow for calculating the width and the slope cut, which require topographic stakes placed.

To open the route, Conavi hired companies with trucks or excavators that charge on a per hour basis.

According to Cambronero, the Head of Conavi should define the layout. This is an engineer surnamed Serrano who is now suspended due to an investigation about supposed handouts in the project.

Gerardo Prada, also a partner at Cacisa, said the machine operators received orders to open the dirt road on the riverbank. Nonetheless, he and Saenz sustained that even so, it was necessary to avoid topographic obstacles such as hills, wetlands or very steep plots of land.

For Saenz, the kilometers closest to the area in conflict properly made under the chosen manner due to the urgency; but the rest deserved a basic plan: "We are in the XXI Century. This requires a design, this road is like going from San Jose to Moin, and it is a very large road. To think about making 150 kilometers with just machines, without design (…) I'm referring to mere professional diligence… it is not done in this manner".

The CFIA Director also expressed concern due to the lack of drainage: "A great deal of the investment might end up lost with a few rainfalls."

No One Responsible – Vargas confirmed that the School of Professionals decided that Conavi did not report to them who was the professional responsible for the work and did not deliver any design plans to them.

According to Vargas, the fact that work began under the umbrella of an emergency decree (signed in March 2011) did not exempt Conavi from making those reports.

Jose Luis Salas, Executive Director of Conavi, sustained that design plans were not available due to an emergency. "There was no time", he explained.

Salas sustained that Conavi and Cacisa make topographic surveys to review the geometric design, improve slopes, curves and water contention systems. He denied that the absence of design plans due to force majeure caused a rise in costs.

Marcela Cantero collaborated

Annex 32

El País, Costa Rica “ Faced with criticism, Conavi confirms to have done work on 332 kilometers of roads around Route 1856”

26 May 2012

Faced with criticism, Conavi confirms to have done work on 332 kilometers of roads around Route 1856

Source: Carlos Salazar Fernández | 2012-05-26. El Pais.cr

Section of Route 1856 near Delta Costa Rica. Photo by Carlos Salazar.

San José, 26 May (elpais.cr) – Given the wave of criticism for corruption, lack of environmental studies and plans, among others, to build the trail known as Route 1856, the National Roads Authority (Conavi) defended all actions taken and says to have done work on 332 kilometers of road, in addition to the 160 of the new road.

In a statement, published on the Presidential webpage, Conavi maintains that these works were done in a context of national emergency, "and faced with a situation that clearly and obviously affected the sovereignty and security of our country".

"Failing to recognize and understand that this was the situation, would lead any person to make judgments of opinion based on an incomplete assessment of the facts and circumstances", says the bulletin.

Conavi argues that with those conditions it was necessary to act quickly, "but within the framework of discretion, that is, motivated based on the best interests of the nation. In fact, an Emergency Decree was issued in order to give context to the nature of the situation".

After insisting on legality, Conavi added that for this reason it should be understood that the work of starting the trail could not be subjected to the procedures for development of infrastructure projects that take into account, for example, stages of conceptualization, feasibility, design and management of the work.

“But, not having done that is not synonymous with acting without a proper and speedy analysis for the decision that was made”, it is added.

“The route was built as a trail, nothing more or less, under the conditions indicated and that is the way it is; in a development process in which all the work done on it improves it and will increase the level of performance”, it is explained.

It is stressed that it is necessary to clarify that in addition to the trail, whose length is currently estimated at 160 kilometers, significant works were done on several access roads to the trail itself. In fact the total length of access roads that were worked on exceeds 332 kilometers.

Conavi went on to say that "the above is very important because we have to understand then that the work associated with Route 1856 must be appraised in a comprehensive way, at a regional level and not as a single communication route”.

On allegations of corruption, the Conavi bulletin says that the necessary actions will be taken in order to punish those who should be punished. "We respectfully await the processes of the Public Ministry and of our Internal Audit to proceed accordingly”, thus is stated.

After promising that the mistakes made will not be repeated, the government promises that the work will continue and that it will be done using the prescribed procedures and with control levels.

“There is work to do: we need to finish the ballasting, place drainage systems and sewers, we have to put up bridges, some of them very expensive. However, in a gradual way we will be improving the road so that it can be used properly to benefit the people in the area, and in general, for development of the country”, thus finishes the statement.

Annex 33

La Nación, Costa Rica “The damage had already taken place”

24 May 2012.

Ana Lorena Guevara

'The Damage had already taken place'

Ana Lorena Guevara Deputy Minister of the Environment

At the end of last year, she decided not to hire a team of experts and to charge floor personnel to assess environmental damages along the road.

Ernesto Rivera erivera@nacion.com 12:00 a.m. 24/05/2012

The Deputy Minister of the Environment, Ana Lorena Guevara, alleges that due to costs and usefulness, she decided to entrust professionals of MINEAT with the assessment of environmental damages caused by the borderline trail.

Isla Calero, politically related with construction of the road, geographically speaking, is many kilometers away. Deputy Minister Bourrouet's approach (in the Emergency Commission) was to hire experts to assess the environmental damage caused by the roadway's construction. You said that due to the urgency and costs, the high-level commission should decide. Who decided and what was decided?

Our work aimed at what was happening in The Hague and the Ministry of Foreign Affairs steered us. In this sense, I posed the concern; we received indications that in the first place, hiring a team of Costa Ricans was very costly and, on the other hand, any report issued by a team of national professionals would not have weight in the trial, since we would be judge and jury.

"When I said that we would resolve it there (in the high-level commission), I was basically thinking about the guidelines from the Ministry of Foreign Affairs.

To provide an immediate response and with lower costs for the country, the decision was to commission a group of experts from the Ministry (of the Environment) itself. They rendered reports and this allowed for a fast assessment in order to submit an environmental management plan to respond to what Nicaragua said."

However, these professionals were also Costa Ricans; they had the same issue with credibility.

Nevertheless, we did not do this for The Hague; we did it so that Costa Rica could demonstrate that we were performing mitigation and compensation actions in the area.

The minutes of the National Environment Commission (CNE for its acronym in Spanish) did not mention The Hague at all; it speaks of assessing damages caused by construction of the roadway…

When discussed in November 2011, the road was already in its execution phase. There was no prevention there. The only thing we could do was to take mitigation and compensation measures because the damage had already taken place.

"It didn't even propose the need for an environmental impact study; we wanted to assess the possible impacts."

The decision not to hire environmental consultants was due to economic reasons.

Yes, there were economic reasons because hiring a team like that one was very costly. In addition, road construction was already underway. The damages or impacts had already taken place.

"Since it was an assessment of damages, the investment would represent a very high cost, and in light of what was under discussion in The Hague, I thought that it would be better to have guidelines from the Ministry of Foreign Affairs. So, if the investment was made, it should serve to solve the environmental mitigation and also to contribute to the proceedings in The Hague."

Who made the decision in the high-level commission?

It was a joint decision, steered by the attorneys from the Ministry of Foreign Affairs, who indicated that this would actually favor us in light of the complaints made by Nicaragua against us.

All constructions have an environmental impact; there were 900 machines in the area along 160 kilometers. Who assessed this environmental impact?

We set up a team of experts with officials from the Ministry, professionals from the conservation areas that toured the entire road span under construction and elaborated an environmental management plan, which contains mitigation proposals.

Annex 34

CONAVI Press Release

25 May 2012

<u>Press release from CONAVI to the public</u>

Because of the serious questions posed by the media about the actions taken by the National Roads Authority (<u>CONAVI</u>) in relation to the construction of Route 1856 and in order to provide citizens with stronger evidence to enable it to form a comprehensive and objective opinion of the circumstances in which the work has been developed, the National Roads Authority clarifies:

1. The first thing that needs to be understood is that the works on Route 1856 were done in a context of national emergency and faced with a situation that clearly and obviously affected the sovereignty and security of our country. Failing to recognize and understand that this was the situation, would lead any person to make judgments of opinion based on an incomplete assessment of the facts and circumstances.

2. The work on Route 1856 was done under those circumstances. Therefore it must be understood that some of the determining factors of the action taken were to act quickly but within the framework of discretion, that is, motivated based on the best interests of the nation. In fact, an Emergency Decree was issued in order to give context to the nature of the situation.

3. As the Costa Rican people will understand, in these circumstances it could not be expected that the works of the route be developed within the framework of standard procedures but rather under the exceptions provided for in the Constitution and the laws of the Republic. In this respect, it should be understood that the work of starting the trail could not be subjected to the procedures for development of infrastructure projects that take into account, for example, stages of conceptualization, feasibility, design and management of the work. But, not having done that is not synonymous with acting without a proper and speedy analysis for the decision that was made.

4. To say at this stage that there was a lack of blueprints or that it was not reported who the professional responsible for the work was, are assessments that we believe are inappropriate within the framework of the best interests of the nation, <u>which</u> have motivated our actions.

5. The route was built as a trail, nothing more or less, under the conditions indicated and <u>that is the way it is</u>; in a development process in which all the work done on it improves it and will increase the level of performance.

6. It is also necessary to clarify that in addition to the trail, whose length is currently estimated at 160 kilometers, significant works were done on several access roads to the trail itself. In fact the total length of access roads that were worked on exceeds 332 kilometers. In other words, the total work done covered over 492 kilometers of roads.

7. The above is very important because we have to understand then that the work associated with Route 1856 must be appraised in a comprehensive way, at a regional level and not as a single communication route. The impact of this set of actions is causing a real transformation of the entire border region of our country, bringing development and hope to the Costa Ricans in that area.

8. Unfortunately the events early this month concerning the management and administration of the work have come to overshadow the positive aspects of the work performed. About this, CONAVI wishes to reiterate that the necessary actions will be taken in order to punish those who should be punished. We respectfully await the processes of the Public Ministry and of our Internal Audit to proceed accordingly.

9. Media coverage should not be the only source of information, but each complex element of what has been presented must be judged. Allow us to say that we at CONAVI are the first to feel committed to care for the the best interests of the nation, but demanding responsibility and punishing those who deserve it.

10. We would like to take this opportunity to inform the Costa Rican people that both MOPT (Ministry of Public Works and Transport) and CONAVI are working to safeguard the route. We would also like to say that we are preparing a work plan for the continuation of the works and we assure you that those works will be done using the prescribed procedures and with levels of control to avoid the mistakes made during the first phase of the project.

11. There is work to do: we need to finish the ballasting, place drainage systems and sewers, we have to put up bridges, some of them very expensive. However, in a gradual way we will be improving the road so that it can be used properly to benefit the people in the area, and in general, for development of the country.

We end this note by stating that despite the vicissitudes that occurred and the difficulties we encounter in our quest to do things right, we at CONAVI will continue to meet our responsibilities while at the same time properly informing the Costa Rican people, not only about Route 1856, but about the large number of projects and work we do on the National Road Network.

25 May 2012

Annex 35

La Nación, Costa Rica "Serious errors expose trail to risk of collapse during the rainy season"

28 May 2012

UCR laboratory inspected Juan Mora Porras route

Serious errors expose trail to risk of collapse during the rainy season

Investments could be lost due to lack of drainage and poorly designed landfills

Lanamme: poor quality of work does not reflect the investment of ¢20,000 million

Ernesto Rivera, Esteban Oviedo and Ronny Rojas erivera@nacion.com 12:00 a.m. 28/05/2012

Much of the ¢20,000 million that the country has invested in building the trail bordering with Nicaragua, could be lost during the next rainy season.

That is the warning given by engineers of the National Laboratory of Materials and Structural Models (Lanamme) of the University of Costa Rica, after inspecting, at the beginning of this month, 97 of the 160 kilometers of this road.

In their report, the experts say that the lack of adequate drainage and the instability of the cut and fills that were performed on route 1856 could become a headache with the arrival of the rains.

"In its present condition, the border trail presents a high risk of collapse during the rainy season", is one of the conclusions of the study.

According to the Lanamme report, the consequences of this possible collapse would result in "a substantial loss of the investments made so far".

During the tour, carried out between Delta Costa Rica and the Pocosol River, the Lanamme mission determined that the steep slopes and the irregular layout of the road were made based on the experience of the machine operators, without taking into account geotechnical or topographical information.

Government authorities have refused to comment on the implications of the study since they claim that they do not know about it yet.

Expensive transports. The goal for Lanamme was to technically assess the configuration, quality and functionality of the works carried out on the trail border.

Another of their findings was the use of unsuitable materials to stabilize the road surface and their transport from far away.

The inspectors found that in some locations large river rocks had been placed as a surface layer.

In other places, very sandy materials had been used that are easily displaced by traffic, wind or water.

"Most of the time, these river materials were hauled from far away and they represent a significant cost. In any case, it is inadmissible to use materials with undesirable characteristics", says the report in its conclusions.

The Government announced the construction of the trail as an alternative to using the San Juan River for the transit of people and goods at the border with Nicaragua.

Its construction was carried out under the protection of emergency decree number 36.440, signed by President Laura Chinchilla, which permitted the availability of lots of funds and the avoidance of the controls of environmental legislation.

The Lanamme report advises that, despite the state of emergency, the design problems could have been solved in a short time, using georeferencing techniques and software to guide the engineering of the work.

They used containers. One of the threats that the border trail is currently facing is the lack of adequate drainage to channel the flow of rain that will fall during the coming months.

The engineers found out that during the construction of the route containers were placed (the kind that is used to transport goods) as structures for water drainage.

Due to falling materials, these containers are already deformed and at risk of collapse, as is evidenced by the photographs included in the report.

"As long as it is not clear what the implications of the study are, or what the validity is of the statements made in it, it would be irresponsible to make any comment", the minister of Communication, Francisco Chacón, said yesterday to *La Nación.*

Meanwhile, Luis Salas, executive director of the National Roads Authority (Conavi), pointed out that he would like to read the document before expressing an opinion.

"The objective was to grow to, not to build immediately, a road as we all may have wanted. Of course the geometric design was not carried out, because it is a trail", Salas asserted.

Annex 36

Diario Extra, Costa Rica "Government acknowledges mistakes in the construction of the trail", available at http://www.diarioextra.com/2012/mayo/30/nacionales13.php

30 May 2012

GOVERNMENT ACKNOWLEDGES MISTAKES IN THE CONSTRUCTION OF THE TRAIL

MIREN MARTÍNEZ / KRISSIA MORRIS

mmartinez@diarioextra.com

After weeks of silence, government officials came forward to meet the information disclosed in the media about route 1856, popularly known as the border trail. They acknowledged errors such as the lack of blueprints and environmental impact studies for the construction of it. They justified that the latter was due to the urgent need to have a road in that area as quickly as possible.

route 1856, Juan Mora Porras, under construction.

According to the Minister of Communication Francisco Chacon, it is justified, in view of the emergency decree issued in February of last year for the construction of the border trail, that not all the requirements had been fulfilled, such as those blueprints.

Meanwhile, Deputy Foreign Minister Carlos Roverssi stated that there is no environmental impact which damages the San Juan River, as the presence of significant sedimentation has not been detected.

On this matter he further argued that there is no evidence proving irreversible damage and that the work will continue with mitigation plans.

Fishman demands accountability

Luis Fishman, faction leader of the Social Christian Unity Party PUSC, misses no chance to clear up any lingering doubts. Taking advantage of the audience with Finance Minister Edgar Ayales that took place yesterday at the meeting of the Ordinary Standing Committee for Financial Affairs, in relation to the presentation of a fiscal strategy, Fishman took the opportunity to hand over a letter demanding information about the 32 companies that have participated in the border trail and that have been paid ¢17,550 million.

"We want to know the tax status of these companies, if they are properly registered, if they have paid taxes and all information concerning the case", declared Fishman.

Annex 37

El País, Costa Rica "Environmental Court Confirmed Excessive Felling for Construction of 1856 Trail"

15 July 2012

Environmental Court Confirmed Excessive Felling for Construction of 1856 Trail

Source: Elpais.cr | 2012-07-15

San Jose, July 15 (elpais.cr) – The Administrative Environmental Court (TAA for its acronym in Spanish), ordered Conavi to submit, within ten days, a Mitigation, Reparation and Compensation Plan for environmental damages caused during construction of the 1856 Route, parallel to the San Juan River

Additionally, it ordered the National Conservation Area System (SINAC for its Spanish acronym), to create a commission composed of 20 specialists to gather information about all of the affected areas.

TAA informed in a press release that it confirmed excessive felling in several stretches and some parts, "clearances" opened that exceed the established width of the trail by eight times.

The Court confirmed damages in Costa Rican territory but found no evidence of sediments dragged into the San Juan River.

On Friday, the TAA issued an injunction against the National Roads Counsel (CONAVI), so that it immediately submits a Mitigation, Reparation and Compensation Plan for damages caused by the construction of the Borderline Trail (Road 1856), in the counties bordering with Nicaragua, including La Cruz, Upala, Los Chiles, Sarapiquí, San Carlos and Pococí.

The should be ready for submittal within ten working days and the corresponding authorities should approve it; the various Conservation Areas of the National Conservation Area System involved in the trail construction area are to receive the information.

The same TAA Resolution orders the SINAC Director to create, immediately, a commission integrated by at least 20 officials, including forestry, biology and technical experts with ample field expertise to coordinate a survey of the affected areas due to construction of the borderline trail. In the same manner, it orders the MINAET Geology and Mines Director to inspect all of the sites for material extraction and/or used in building the trail, as well as those located along the stretch. The Director of the Water Department received orders for a joint inspection with conservation area officials that will compose the commission to survey all possible waterways affected by the construction of the borderline trail, in addition to performing the respective economic assessment of all possible environmental damages.

Once the studies are ready, these MINAET departments must immediately and jointly elaborate a Mitigation, Reparation and Compensation Plan for possible environmental damages and an economic valuation of these damages, according to their areas of competence.

In addition, the Environmental Court's Resolution made a request to the President of the Federated School of Engineers and Architects to facilitate a certified copy of the reports made by such entity regarding issues due to possible environmental damages found in the construction of the borderline trail. The Court made the same request to the Executive Director of the National Laboratory for Materials and Structural Models (Lanamme) of the University of Costa Rica.

Damages Found

The TAA confirmed serious environmental damages along various stretches of the 1856 borderline trail in the first inspection report submitted this week, after touring trail grounds last June 27 to 29, and an over-flight performed on April 10.

The ground inspection encompassed trail spans for a total 49 kilometers; one of the most serious and verified affectations was excessive and unjustified felling beyond the ten-meter width that the trail should have.

"Tree felling at the edge of the trail was not rational, limited or proportional for purposes of the road; to the contrary, in some sectors they went in with heavy equipment and extracted lumber, mainly almonds and other valuable species", states the TAA Technical Report.

In the Tiricias and Infiernillo River, field opening for trail construction exceeds by eight times, the width of the trail and there are considerable affectations to the forest area.

The TAA highlighted, "Opening of a "clearance" so large in the forest was unnecessary to open a trail that does not exceed 10 meters width and for several hundred meters".

Some sectors along this trail span, we found almond trees cut in 4 rods, apparently ready or in landing position.

For this reason, one of the recommendations of the TAA technical experts is that the SINAC Departments for the Conservation Areas Arenal-Huetar Norte, the Central Volcanic Range and Tortuguero should set up a strategy in all trail jurisdiction sectors to control forest industries and sawmills. The intention is to avoid possible almond tree lumber trade, and commercialization of other tree species that may eventually come for the trail sectors and adjacent areas.

The report also advices that in some points, the path has a width of up to 20 meters, also affecting the forest resources and large land movements unnecessarily, without performing the necessary soil conservation works.

More Affectations

The Environmental Court found that just along the first 49 kilometers inspected, specialists detected more than 10 wetlands and water bodies affected, according to the TAA Technical Report.

At least seven rivers, streams and creeks display different types of damages, due to deviation of their watercourse, and canalization, piping, tapping or clogging of the waterways with sedimentation.

For example, the Infiernillo River modified its watercourse and the protection area of the water body clogged with sedimentation. This river's watercourse strangled with rock to shorten the distance for building a bridge. In the future, this situation may place the bridge structure and the physical integrity of people circulating in the site under danger. An eventual flood or strong waterfront will collapse and bring down the bridge and its foundations. In addition, the bridge made of almond wood, used a banned and protected species.

Likewise, TAA specialists detected affectations to at least six wetlands along the first stretch subject to inspection. These affectations include landfills by clogging the wetland with mismanaged sediments or directly by desiccation.

For example, at the height of the Pocosol River, strong soil movement observed, landfills to raise the plot of land, channeling of a possible water body and a wetland, which was apparently desiccated.

Mismanaged Sediments

Another environmental problem found along several stretches of the borderline trail is that they made strong land movements, in many cases excessive for the trail dimensions, without their respective conservation works.

On the other hand, forest areas are flooding due landfills and mishandled sediment transport, which clogged waters, leaving them without an outlet. Some sectors along the Tiricias Road show how some trees are dead because of clogged soils from material deposits made in the site, or by accumulated waters that need venting, or the same sediment drag due to lack of soil conservation works.

At another point, sewage clogged that should evacuate waters that run through the place. There are landslides with volumes that deposit into the waterway or depression. Consequently, peripheral trees in the flooded area died due to flooding in the forest area.

In some locations, they placed saran wrap to retain sediments, but in fact, this does not work to retain such amounts of sediment. They should have performed other types of retention and soil conservation works.

In the environmental cause regarding the 1856 trail, CONAVI is the first entity under investigation, but imputations against other entities or private enterprises not dismissed, once the Environmental Court advances its investigations.

Environmental in Road Number 1856

(First TAA Technical Report, July 2012)

- Material exploitation and extraction
- Affectations in forest areas due to clearings for the trail; unnecessary and unjustified expansion of land plots surrounding it
- Changes in soil use, including inalienable areas
- Possible felling and exploitation of banned trees under Decree 25700-MINAE, threatened species and the case of the almond trees, which is the most cut and exploited species in this case
- Affectations to water resources (possibly, waterways of public domain), through surface runoff, water erosion and in the end, clogging
- Land movements without performing soil conservation works
- Forest felling and exploitation outside of the trail area without relying on permits from the State Forestry Authority (AFE for its Spanish acronym)
- Affectation to wetlands of diverse nature
- Interruption of the natural biological corridors
- Private possession of land plots located within the Borderline Strip (/2 kilometers), which constitute public concessions since 1828
- Affectation to the landscape beauty in different sectors
- Invasion and precarious settlements in the inalienable area

Annex 38

El País, Costa Rica "Road 1856: First Study by the TAA Points Out Impacts to the Protection Area of the San Juan River"

26 July 2012

Road 1856: First Study by the TAA Points Out Impacts to the Protection Area of the San Juan River

Source: Elpais.cr | 2012-07-26

Road 1856: First Study by the TAA Points Out Impacts to the Area of Protection of the San Juan River – Showing Image II of 3

San Jose, July 26 (elpais.cr) – A preliminary report received by the Administrative Environmental Court, upon inspection of the area along Road 1856, determined that there is invasion to areas of protection of some waterways, including the San Juan River on the Costa Rican side.

The study, submitted by experts of the TAA on last June 21, indicates that the roadway opened on the borderline, parallel to the San Juan River, not only consists of a main road but also side roads derived from it.

It is worth highlighting that after an air inspection and another on land, last week the TAA ordered the National Road Council (CONVI) to implement a series of mitigation works and issued orders to several institutions to create a team of experts to assess damages and propose solutions to the environmental destruction.

The report, backed by dozens of aerial photographs, states, “Apparently, areas for protection of some waterways are invaded, including the San Juan River”, on the Costa Rican side.

It emphasizes that some spans along the road are located within the inalienable 50 meters from the borderline, always within the Costa Rican side.

Moreover, there are changes in the use of soils in forest areas resulting from changes in these conditions due to the opening for the roadway.

The report contends that there are changes in the use of soils within wetland ecosystems upon creation of dykes and side roads that interrupt the natural cycle of these ecosystems.

The report highlights that, “Apparently, there is erosion and sediment-laden toward the rivers, freshwater marshes and lakes”. However, the study clarifies that there are no sediments washed into the San Juan River.

On the other hand, on the other hand, the report highlights that the opening for the road within forests and wetlands, as well as the use of pits, among other factors, alter the nature and condition of the original landscape.

“The changes in the forested and wetland landscapes modify or destroy habitats or niches for many fauna species, which implies perturbation in their behavior”, are according to the preliminary report.

The report states that the material works took place within a Wildlife Protected Area (WPA), without relying on a design plan for the works, or an environmental impact study, mitigation or compensation plan.

The report states "Implementation of a work of this magnitude under the argument of protection of the country's sovereignty in the face of a possible Nicaraguan invasion does not justify that the works took place in a specific site that did not encompass the precise area where most ecological impacts happened. The need to provide transportation facilities to inhabitants in the area does not justify it either, because these lands are public assets and landholders contributed to the destruction of the biodiversity existing in the area, and they continue to change the natural panorama of the place".

The report also says, "The Government of the Republic itself transgressed all of the environmental regulations, both national and international, despite its authority to declare a state of emergency by an executive decree. It should have been responsibly planned".

Furthermore, it summarizes that damage to the environment are obvious and should be punctuated, described, evaluated and assessed.

Recommendations:

- TAA experts recommend performance of a detailed investigation, on land, to verify possible impacts to the biodiversity within the scope of influence along the borderline road.

- Request certified copies of reports arising from their possible inspections in the area of interest, as well as rigorous inspections and their respective reports to this Court, from the Areas of Conservation with jurisdiction in the northern borderline. This is the second request.

- The same team requests an economic assessment from the Areas of Conservation, within their scope of competence.

- Likewise, the National Environmental Technical Secretariat (SETENA for its acronym in Spanish) should issue a certification of the environmental feasibility granted to open the roadway.

- On the other hand, it recommends that CONAVI should implement mitigation tasks for influences or damages as soon as possible, prior assessment, clearance or approval by the Areas of Conservation Areas and SETENA.

- Moreover, it suggests requesting specific criteria from the Water Works Department on impacts to water bodies (streams, springs) and their respective economic assessment of environmental damages.

- Another recommendation is to "Request the Geology and Mines Department their respective criteria on the opening and use of river gorges, river materials and any other within their scope of competence, as well as their respective economic assessment of environmental damages".

- The National System of Areas of Conservation (SINAC) should inspect and issue criteria, within its scope of competence, to the Executive Direction of SINAC in relation to the wetlands.

Finally, the report suggests that TAA should file provisional remedies to avoid or reduce the environmental damage, guarantee the feasibility of the ecosystems, and respect for national and international regulations.

Annex 39

La Nación, Costa Rica “Border Roadway presents more Collapsing”

13 August 2012

Other Spans of the Road Subside with Rains

Border Roadway presents more Collapsing

Bridge along the span from Chorreras to the San Carlos Rivermouth Collapsed

Government denies abandonment and assures that it works on ballasting and placing bridges

http://www.nacion.com/2012-08-13/ElPais/Carretera-fronteriza-presenta-mas-hundimientos.aspx?Page=2

Carlos Hernández, Correspondent - 12:00 a.m. 13/08/2012

San Carlo – The denominated border road disappears like a sugar cube in a water recipient

Images /Photos

+ MULTIMEDIA

This time it was the bridge over Chorreras Brook that collapsed in the face of heavy rainfall, which interrupted passage along the span from Chorreras to San Juan River Mouth.

In addition, the road remained parted into pieces to the point of forming a hole with large dimensions that continues to grow with the rainfall.

Likewise, a kilometer to the west of Tiricias de Cutris, the bridge over the Tiricias River is sinking, passageway that threatens to fall into the waterway at any moment because of its deterioration.

Families that live between Tiricias and milestone one warned that other spans are crumbling. They fear being without communications in the very short term.

“The parallel (road) is disintegrating like a napkin in water while the Ministry of Public Works suspended its maintenance”, claimed Mario Cambronero, farmer in the area.

“They are not providing maintenance and destruction will continue. Its reconstruction will cost millions to the Government”, said Omar Cortez, a neighbor in Tiricias.

The Ministry of Public Works and Transportation (MOPT for its acronym in Spanish) denied that it abandoned the route, according to a paid publication in this news media yesterday.

The entity assured that it continues its task ballasting and placing temporary sewages and bailey bridges. In addition, it explained that procurement of permanent and environmental mitigation works progress.

Apparent irregularities in procurement processes and lumber extraction activities motivated investigations by the Attorney General’s Office and the Legislative Assembly.

According to MOPT, it has already invested ¢24.000 million.

By spans – if one reviews the route by spans, few areas do not present problems.

From Punta Cortes up to Cuatro Esquinas de Los Chiles, it is a dirt road and only double traction vehicles can transit on it.

From Isla Chica, travelling along the road, up to Delicias de Los Chiles, the roadway has cracks, subsidence and fallen bridges. In the meantime, from Pocosol River toward San Isidro and Tiricias de Cutris, transit is difficult along certain spans.

From Tiricias to Chorretas and from there to San Carlos River Mouth there is no passing; the same is true between Cureña and Tambor because two bridges devastated.

The only areas for transit without any problems are the span that goes from Boca Sarapiqui up to the Costa Rica Delta, where the project ends.

Annex 40

La Nación, Costa Rica "The Ministry for Public Works and Transport will sign contracts for conclusion of project"

29 August 2012

The Ministry for Public Works and Transport will sign contracts for conclusion of project

ALVARO MURILLO, alvaromurillo@nacion.com, 12am 8/29/2012

The design work and supervision for finishing and consolidating the borderline road known as Route 1856 will be contracted out by the government, according to an announcement yesterday by the president Laura Chinchilla during a press conference that followed the Government Council meeting.

The presidente assured that out-going Minister of Public Works and Transport (MOPT by its Spanish acronym), Luis Llach, left in place a procedure for concluding the second stage of the so-called borderline road.

Chinchilla said that "final design for the project would be determined through public bidding for the contract."

The government also intends to put together a supervision team to ensure "clarity as to responsibility for upcoming stages of the project" and "who is ultimately accountable.

The Government is also seeking the source of funding conclusion of the road project.

The plan is that by January all processes be ready for reinitiation of the project during the dry season.

"We trust that all these factors, financing, design, equipment and a timetable will be in place in order to take off with the project in the summer; therefore, the second stage work wouldl have to begin in January and that would mean the definitive consolidation of Route 1856," said the leader.

Chinchilla explained that the government "never" intended to build a concrete paved road likened to a highway, "but rather a road that connects several towns."