NOTITIE 3

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Background

The "East Point Planning Study" (from here the "Oostpunt Study") was sponsored by the Executive Council of the Government of Curaçao. This document was finalized on 31 May 2011. It was downloaded from the website of the Government of Curaçao in November 2012. The Oostpunt Study was prepared with input from Wolff Landscape Architecture, Inc ("Wolff"), Langan International, LLC ("Langan"), and EcoPlan, Inc ("EcoPlan"). Within the Oostpunt Study is an "Environmental and Ecological Assessment Report" and an "Infrastructure Assessment and Sustainability Report," both of which are attributed entirely to Langan in the text of the study.

The "Economic Impact Study" ("EIS") was prepared by KPMG The Netherlands, KPMG Curaçao, and Decisio (from here on abbreviated as "KPMG"). It was finalized on 13 May 2011 and downloaded from the website of the Government of Curaçao in November 2012.

A public presentation of the proposed zoning plan and other aspects of the Planning Study were presented on Curaçao on 30 October 2012 by the Eastpoint Planning Committee and representatives of Wolff (Ted Wolff) and Langan (Eric Schwarz). This presentation is referenced below as the "Public Presentation."

These comments were written in English similar to the Oostpunt study.

Overview of issues related to statements and findings related to the marine environment as described in the Oostpunt Study, dated 31 May 2011, conducted by Wolff, Langan, et al., as provided through the Curaçao government's website and made available at the Ministry of VVRP

The coral reefs of Oostpunt and surrounding areas are of great conservation importance, and are inadequately protected. No further local land-based sources of stress should be permitted to them. The proposed development would greatly increase stresses and would almost certainly tip the reefs into irreversible degradation. The Oostpunt Study wholly fails to point this out, due to a failure to adequately interpret the basic information provided to the study authors by Carmabi or collect such information from (largely freely available) reports and scientific studies on this topic. The proposed development should be rejected as it represents a death knell for these coral reefs. Failure to reject this development plan will raise questions about the seriousness and legitimacy of Curaçao's protection and management of its natural resources.

The Oostpunt Study neglects and/or misses crucial information on the presence and workings of species and ecosystem types typical for Curaçao. Examples include, but are not limited, to: the impacts of storms, the role of beaches for nesting sea turtles, the nursery function of inland bays, endemic species, endangered species (e.g., elkhorn corals), etc.

The information used to compile the Ecological Assessment is incomplete

The Environmental and Ecological Assessment of Oostpunt, which is a sub-component of the larger Oostpunt Study, was prepared by Langan International. In this document, Langan states that the environmental assessment was conducted using: (1) literature, yet they cite only one scientific paper, one book, one PDF report, and one website; (2) professional experience, yet they have little to no experience working in the Caribbean and zero experience working near pristine coral reefs; (3) interviews with the landowner, yet this is an inadequate and superficial method for investigating complex and fragile environmental systems that span terrestrial and aquatic habitats; and (4) site visits, yet they spent very few days on Curaçao and admitted that did not snorkel or dive even one single time. On page 1 of their report, we read that they visited the Oostpunt area for a total of 3 days in February 2011. Furthermore, from the meeting minutes Langan has

included in the Oostpunt Study, it is clear that much of their time on Curaçao was spent meeting with utility and infrastructure companies on Curaçao such as Aquaelectra and Selikor, reducing the total time they could have actually spent investigating the area at Oostpunt. Both the short nature of this visit as well as the "one-time" nature of this visit preclude that reliable or complete inventories could have been generated of the local ecosystems, of the abundance of (rare) species, and of the potential seasonal dynamics that could affect the decision making process. Consequently, we state that such limited investigation is insufficient to serve as a basis for a study that potentially leads to the rezoning and/or development of an area that comprises nearly 10% of Curaçao's total surface.

Basic information presented on Oostpunt's reefs is incorrect

In their assessment of the Oostpunt area, Langan International writes in the Executive Summary: "*Within the sea that wraps around Eastpoint on the northeast and south coasts are offshore coral reefs. The Curaçao Marine Park was established to protect the sensitive coral reefs along the south coast. Outside of the Marine Park the reef extends around Oostpunt and along the north coast.*" There are numerous factual inaccuracies in these statements. First, a Marine Park does not protect reefs at all from terrestrial pollution and run-off. Second, the Marine Park is not actively managed due to lack of funding by the government. Given these facts, it is simply not true to state that the reefs of Oostpunt currently receive any form of protection. Third, the reefs near Oostpunt are NOT "offshore," i.e., they are not barrier reefs and they are not set any distance away from the shore. This statement by Langan International raises the false impression that Oostpunt reefs are found at an appreciable distance away from shore which would reduce the effects of terrestrial stressors (e.g., run-off, sediments, chemical pollution, fertilizers, garbage, oil, etc). This inaccuracy reveals the consultants' ignorance with regard to Caribbean coral reef ecology and biology. In fact, only three pages of the Oostpunt Study concern Oostpunt's coral reefs, out of 200 total pages and the overall level of scholarship is astoundingly poor.

Failure to describe the impacts on critically endangered coral species

The authors of the Oostpunt Study note the high abundance of *Acropora* corals at East Point but fail to mention the most commonly-cited fact about these two species of coral: that they are the most critically endangered in the entire Caribbean (IUCN Red List "critically endangered," USA Endangered Species Act "threatened"). The fact that such information was not included in their

assessment (1) reveals Langan's "lax" attitude toward coral reefs, which is unacceptable for a consulting firm working in a sensitive area like Oostpunt and (2) reveals poor scholarship, lack of expertise, and/or deliberate obfuscation of well-known facts. For example, in a Google search for "Caribbean Acropora," the first five results describe its endangered species status, as well as restoration techniques, demographic monitoring programs including work on Curaçao, species recovery plans, historical species decline and loss of 98% of colonies Caribbean-wide, as well as the high threat of coral disease in *Acropora*.

The Oostpunt Study fails at even the simplest forms of information gathering

To illustrate this statement we use Langan's statement on page 12 of the Environmental and Ecological Assessment (Coral Reef Section 3.4.1) where they state, following a description of monitoring efforts on Oostpunt's reefs conducted in the early 1980's: "We are unaware of any more recent mapping of the coral reefs in this area." Such statement exposes the critical lack of scholarly ability at this international engineering firm. In a Google search for "Oostpunt Curaçao survey," the first two hits describe AGRRA surveys at Oostpunt (Atlantic and Gulf Rapid Reef Assessment), all conducted after the study referred to by Langan. A Google search of "East Point Curaçao transects" yields 1.4 Million hits. The first hit is to the EU's FORCE project survey data (Future of Reefs in a Changing Environment). The next few hits describe Reef Care, NOAA, and ZMT Bremen scientific surveys of the area that were all conducted in the recent past. Again, the inability to find such readily-available information clearly illustrates the critical lack of scholarly ability and/or effort at Langan and shows that recent and widely-available (relevant) information was not included in their Environmental and Ecological Assessment.

Langan follows their statement mentioned above with their subsequent statement, "Therefore it is not clear to what extent the nature or extent or quality of the reefs may have changed in the subsequent 25 years" (i.e., between the 1984 study they quote and any more recent studies that according to Langan are not available). To illustrate their inability to gather relevant information, a Google search for, "state of Curaçao's coral reefs" immediately produces the Carmabi report "State of Curaçao's Coral Reefs." This Carmabi report provides a detailed overview of the state of Curaçao's reefs, including those at Oostpunt (and strangely was used elsewhere in the Oostpunt study, in section 3.4.1. "*Coral Reefs/Caribbean Sea*." Again, the inability to find or use such readily-available information clearly illustrates the critical lack of care, lack of effort, lack of

scholarly skills, lack of biological expertise and/or a possible deliberate obfuscation of known facts.

Failure to adequately consider the effects of terrestrial run-off on marine ecosystems

In the Environmental and Ecological Assessment, Langan International states, "*The health of coral reefs can adversely be affected by impaired water quality resulting from increased sedimentation and siltation and dissolved nutrients and chemicals carried in storm water runoff and sanitary sewage discharge from developed areas*." (section 3.4.1., page 12). The only follow-up comment they write concerns storm water runoff, stating that capture and reuse of storm water will prevent adverse impacts to water quality and coral reefs. Again, the authors fail here to provide a complete assessment of factors associated with run-off events: (1) nothing is written about chemical runoff from golf courses, parking lots, landscaping, etc.; (2) nothing is written about chemical input from marine activities – boat fuel, oil, antifoulant paint, sewage, soaps, etc; (3) nothing is written about (subterraneous) sewage leaching from land, sewage from boats, sewage from broken pipes, sewage system overflows, damage to sewage systems from storms/hurricanes, leaching sewage from broken septic tanks; (4) nothing is written about fertilizers from landscaping, fertilizers from golf courses, fertilizers from hotels, etc; (5) nothing is written about pesticides, herbicides, insecticides washing from landscaping, hotels, golf courses into the water; (6) nothing is written about water discharges from hotel pools, hotel laundry, hotel dry cleaning, etc.; and (7) nothing is written about shedding of fecal pathogens by humans swimming in the bays (e.g., *Staphylococcus aureus* strains shed by tourists at Waikiki Beach). Information regarding these varied threats to coral reefs was send to Wolff et al. on 2 March 2011 by Carmabi. (See page 7 "The authors of the Oostpunt Study have not used the extensive amount…). Despite the fact that Langan was in possession of information to adequately assess negative effects of the proposed development in terms of run-off and associated events, they appear to have deliberately chosen did not to include this information. Again, as above, this shows lack of care, lack of effort, lack of scholarly skills, lack of biological expertise and/or possible deliberate obfuscation of known facts.

Failure to include many relevant aspects of coral reef ecology and human influences

In addition to marginally referring to (rather than discussing the impact of) run-off (see above), in the Environmental and Ecological Asessement, Langan mentions only one additional aspect of

human activity - “decreased light penetration and direct physical impacts such as from one-time events such as ship grounding, channelization, or from repeated events such as boat anchorage” as a potential stressor that could contribute to the degradation of Oostpunt’s marine ecosystems. Their section on coral reefs (3.4.1) fails to include many known aspects related to coral reef ecology and potential stressors that are relevant to make informed decisions about the potential for development at Oostpunt. To illustrate the lack of information provided, the report’s major omissions include:

1. Role of Oostpunt as up-current larval supply for rest of the island
2. Endangered species habitat
3. Endangered coral species
4. Uniquely high genetic diversity of corals at Oostpunt
5. Endangered groupers at Oostpunt
6. Endangered sharks at Oostpunt
7. Sea bird habitat
8. Low coral disease prevalence at Oostpunt
9. Coral bleaching rates and risk at Oostpunt
10. Effects of development on coral disease
11. Effects of development on coral bleaching
12. Role of Oostpunt bays as nursery habitat for reef fish (see work by Nagelkerken)
13. Effect of marinas, boats, oil, gasoline, soap, and human sewage from boats on reef health
14. Turtle habitat and nesting beaches at Oostpunt
15. Role of East Point as high-value, exclusive dive site for Curaçao dive industry
16. Permeability of limestone and risk of sewage leaking out to reef
17. Long-term time series of nutrient data at East Point (Reef Care Curaçao; freely available online)
18. Curaçao reef health relative to the rest of the Caribbean (IUCN)
19. Oostpunt reef health relative to the rest of Curaçao (Carmabi, IUCN, etc)
20. That Curaçao has a very high dependency on healthy reefs (World Resources Institute)
21. That reefs on Curaçao are at very high threat from human activity (World Resources Institute)

22. Studies showing decline of coral communities in nearby Spaanse Water due to coastal development (see work by Debrot)
23. Role of artisanal fishing on Oostpunt reefs as cultural heritage
24. The risk of coral disease, including the fact that coral disease may be spread by humans, may be caused by human sewage or may be worsened by human-induced stress
25. The impact of tourists themselves on the reefs – abrasion, trampling, kicking, collecting items underwater, stressing marine life, fishing, anchoring, throwing trash, etc

Nothing is written as to how these unique resources would be protected and how these threats would be avoided or mitigated. All abovementioned aspects can be supported by scientific studies or research reports that have not been included in the Langan report, even superficially. Again, this information is easily-accessible online and information regarding many of these issues was sent to Wolff et al on 2 March 2011 by Carmabi (See page 7 "The authors of the Oostpunt Study have not used the extensive amount…).

Notably, examples of any reefs anywhere in the Caribbean that survived construction of tourist development and golf courses nearby are not provided or discussed in the assessment by Langan.

Despite the fact that Langan was in possession of information to adequately assess negative effects of the proposed development in terms of run-off and associated events, they appear to have deliberately chosen not to include this information. Again, we argue that this reveals lack of care, lack of effort, lack of scholarly skills, and lack of biological expertise and/or possible deliberate obfuscation of known facts.

Given the many omissions in the Oostpunt Study, especially in the sections produced by Langan, Carmabi deems the report unsuitable to serve as a basis for future planning studies as it simply lacks much of the information required to make informed decisions in this regard.

Failure to accurately depict current conservation measures

In the coral reef section (3.4.1) of the Environmental and Ecological Assessment, four paragraphs are spent describing the Curaçao Marine Park and Cartagena Conventions. With this, the authors

create a false air of ecosystem security and stability by describing these (currently unenforced) protections. In doing so, they also (1) fail to accurately describe the fragile state of Curaçao's coral reefs; (2) fail to describe the effect of development on reefs; (3) fail to make any suggestions about what should be done to prevent impacts from development; (4) fail to consider whether or not the land and terrestrial ecosystems at Oostpunt are too sensitive to be developed and (5) fail to consider whether or not the reefs of Oostpunt are too sensitive to withstand coastal development.

Failure to include and discuss marine endangered species

In the East Point Planning Study, the section on Rare and Endangered Species (3.6.2) does not discuss any marine species nor does it discuss the expected effect that the proposed development will have on them. In this regard, it is also relevant to state that Curaçao has undersigned to the SPAW protocol of the Cartagena convention which explicitly demands that undersigning parties protect endangered species in general and specifically by establishing protected areas. A large number of Rare, Threatened and Endangered species occur, and in some cases are unusually abundant, in the waters of Oostpunt and include the following:

1. Elkhorn coral (*Acropora palmata*) IUCN Critically endangered, CITES II
2. Staghorn coral (*Acropora cervicornis*) IUCN Critically endangered, CITES II
3. Leatherback sea turtle (*Dermochelys coriacea*) IUCN Critically endangered, CITES I, CMS App. I/II
4. Hawksbill sea turtle (*Eretmochely imbricata*) IUCN Critically endangered, CITES I, CM App. I/II
5. Goliath grouper (*Epinephelus itajara*) IUCN Critically endangered
6. Boulder Star coral (*Montastraea annularis*) IUCN Endangered
7. Mountainous Star coral (*Montastraea faveolata*) IUCN Endangered
8. Green sea turtle (*Chelonia mydas*) IUCN Endangered, CITES I, CMS App. I/II
9. Loggerhead sea turtle (*Caretta caretta*) IUCN Endangered, CITES I, CMS App. I/II
10. Nassau grouper (*Epinephelus striatus*) IUCN Endangered
11. Queen conch (*Strombus gigas*) IUCN Endangered
12. Pillar coral (*Dendrogyra cylindrus*) IUCN Vulnerable, CITES II

13. Lamarck's Sheet coral (*Agaricia lamarcki*) IUCN Vulnerable, CITES II
14. Elliptical Star coral (*Dichocoenina stokesii*) CITES II
15. Olive Ridley sea turtle (*Lepidochelys olivacea*) IUCN Vulnerable, CITES I, CMS App. I/II
16. Mutton snapper (*Lutjanus analis*) IUCN Vulnerable
17. Cubera snapper (*Lutjanus cyanopterus*) IUCN Vulnerable
18. Yellowmouth grouper (*Mycteroperca interstitialis*) IUCN Vulnerable
19. Yellowfinned grouper (*Mycteroperca venenosa*) IUCN Vulnerable
20. Snowy grouper (*Epinephelus niveatus*) IUCN Vulnerable
21. Queen triggerfish (*Balistes vetula*)(IUCN Vulnerable
22. Rainbow parrotfish (*Scarus guacamaia*) IUCN Vulnerable
23. Hogfish (*Lachnolaimus maximus*) IUCN Vulnerable
24. Spinner dolphin (*Stenella longirostris*) CMS App. II
25. Humpack whale (*Megaptera novaeangliae*) CMS App. I

The list above overviews all Migratory, Threatened, Vulnerable, Endangered, and Critically Endangered marine species that are found in the waters surrounding Oostpunt following international guidelines and protocols designed by or resulting from the following organizations and conventions: International Union for Conservation of Nature (IUCN), Convention on International Trade in Endangered Species (CITES), Convention on Migratory Species (CMS).

The inability to find or use this readily-available information further and clearly illustrates Langan's critical lack of care, lack of effort, lack of scholarly skills, lack of biological expertise and/or possible deliberate obfuscation of known facts.

Such omissions in the Environmental and Ecological Assessment have serious consequences. By not including this information in the Oostpunt Study, Langan puts Curaçao in a position to break international treaty obligations. The international reputation of Curaçao is at risk of becoming even more damaged were development to proceed based on this incomplete ecological assessment.

Failure to account for groundwater flow from land to the ocean

No clear description is given in the Langan report of where the nutrients (i.e. compounds containing nitrogen and phosphorus) from the sewage effluents or golf course fertilizers will go. It is simply claimed that the design of the project ensures that no nutrients enter the marine environment. There is no discussion of the fate of these major sources of nutrients from the proposed development. There is no mention at all of groundwater flow downslope along the hydraulic gradient to the sea, even though the aquifer is composed of porous and permeable sands that have almost no ability to retain nitrogen and phosphorus. High leaching and horizontal transport to the coastal zone is inevitable under such circumstances, but it is never mentioned in the study. The entire issue of coastal zone nutrient inputs from sewage and fertilizers is simply ignored, even though this would be the major chronic long-term environmental impact to marine ecosystems at Oostpunt. It is not clear if this is an unwitting omission due to failure to consider the impacts on the reef, or if it is being deliberately ignored in order to focus at length on far lesser impacts as a distractive tactic.

Failure to consider potential bottom instability in areas to be developed

Especially limestone (which makes up much of the southern sections of Oostpunt from the high water line to approximately 1-2 km inland) is characterized by high groundwater flow compared to, for example, the basaltic rock formations that are found in the middle of the Oostpunt area. Developing on limestone areas is considered detrimental to nearby ecosystems as a large variety of pollutants (e.g., pesticides, fertilizers, chemicals, sewage, etc.) are not retained within the limestone rock formations and will eventually carried to the ocean by groundwater flow. In addition, as has been shown elsewhere on the island (e.g., Jeremi, locally in Salina, etc.) such areas are extremely difficult to build on due their porous and thus unstable structures, which are often further weakened by the presence of caves. The presence of caves is especially high in areas lying at the bottom of higher grounds as is the case in Oostpunt. The presence of caves can render nearshore bottom types unsuitable for development. This is surely relevant for the Oostpunt area as evidenced by the many “salt water lakes” near shore that are fed by water from the ocean through subterraneous connections.

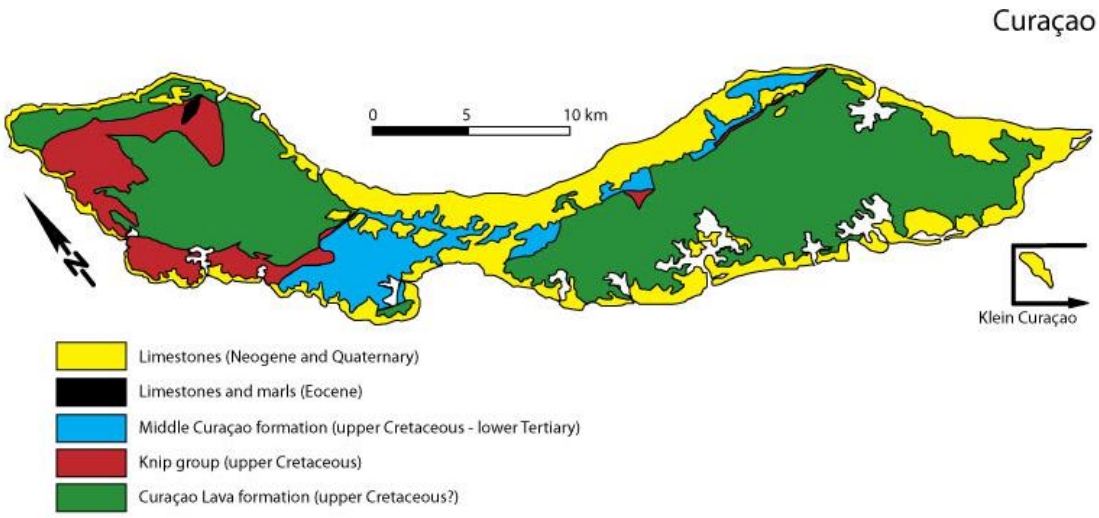

Figure illustrating the location of porous limestone (in yellow and black), i.e., areas where pollutants will easily be transported from land to the ocean by groundwater flow and as such are unsuitable for intensive development

Furthermore, recent experiences show that building in or near the waterline often comes with unexpected surprises as firm ground on which buildings can be constructed is typically only found >40 m below ground level. Such loose undergrounds arose during rapid sea level rises in the recent geological past, which filled in existing underwater depressions with rubble and sediment that now remain as thick layers of unconsolidated or marginally solidified bedrock which are clearly unsuitable for construction. Examples of recent construction projects on Curaçao that met unforeseen problems, expenses, or cancellations due to such unstable undergrounds include the KFC in Salina (resulting in a 3-fold higher building costs than anticipated), the planned cement factory near Rif St. Marie, and the attempted development near Cas Abao (which were both cancelled as structures literally sank into the ground). Nowhere in the Oostpunt Study are these aspects considered which could be extremely relevant for all planned construction in general and the "South Sea type bungalows" proposed by Wolff in particular. There is no evidence in the Oostpunt Study that Langan conducted any geological surveys to examine the feasibility of construction at Oostpunt.

Failure to account for coastal zone nutrient transport to reefs

The implications of the wind, current, storms, and wave data presented for transport of land derived nutrients and sediment are nowhere explained in the study.

Failure to account for sea level rise

Long-term global sea level rise and increasing storm intensity due to climate change are nowhere explained or considered in the Oostpunt Study but these factors must be included to determine whether construction in near shore environments of Curaçao is possible or safe in the future.

Failure to account for storm impacts

The effects of storms such as Lenny (1999) and Omar (2008) is not considered on any aspect of the proposed development scenarios. It seems inevitable that developing close to shore requires such consideration to prevent loss of property and/or an increased flow of debris/waste from land to the ocean during such storms.

An example of how storms can impact near shore developments when storm Omar hit Bonaire's "protected" coast in 2008.

Failure to acknowledge or understand how terrestrial and marine activities from the proposed development of the Oostpunt area would degrade Oostpunt's coral reefs

It is apparent from the superficial treatment of coral reefs in the entire Oostpunt Study (particularly by Langan in their Environmental and Ecological Assessment), and from the verbal

statements regarding reefs made by representatives from Wolff and Langan at their public presentation on 30 October 2012, that the firms hired to prepare the Oostpunt Study do not in fact know how coastal development affects coral reefs (or, that they have chosen to mislead Curaçaoan officials by omitting this knowledge). Langan briefly considered only the effects of sedimentation and ship/anchor damage on reefs in their report. Ted Wolff included "no effect on offshore coral reefs" as one of the planning principles used in creating the zoning plan; he expressed confidence multiple times in his presentation that the coral reefs of Oostpunt would not be affected by the proposed zoning plan because draining swales would be left intact and no construction would occur over the water or wetlands. In sum, verbal and written statements made by Wolff et al. specifically promise and repeatedly imply that the proposed developments at Oostpunt would not damage Curaçao's reefs. We disagree. Below, we provide a comprehensive survey of the scientific evidence showing that coastal development degrades, damages, and destroys coral reef ecosystems. We include scientific data from Curaçao itself.

According to the World Resources Institute, the four major local-scale threats to coral reefs are: coastal development, watershed-based pollution, marine-based pollution and damage, and overfishing (Burke et al. 2011). Because the global threats of climate change and ocean acidification pose significant risks, this requires governments to take extra precaution in preventing local-scale threats such as coastal development. Threats to coral reefs from coastal development include costal construction and engineering, filling and moving of land, runoff from construction, sewage discharge into waters, sewage seeping or leaching from the ground, and the impact of unsustainable levels of tourism (Burke et al. 2011). According to Cesar (2003), the main threats to coral reefs are: runoff, pollution, tourism overuse, destructive fishing and coral bleaching.

Construction near coral reefs poses a significant risk to reef health, as does any construction in waters near coral reefs, or any construction that interferes with normal channels of water flow on land. Construction in the water and directly on the coast, such as construction or reinforcement of beaches or seawalls, construction of piers, and construction of a marina infrastructure can all change water flows, alter water currents, and deliver deadly sediments to coral reefs long distances from the location of construction (Burke et al. 2011). Construction kills corals by altering seawater exchange rates, by altering food supplies for fishes and the supply of larvae to reefs. Any construction that alters mangrove or seagrass habitats creates a direct threat to fisheries, as juvenile fishes depend on these habitats for their early years of life. Dredging for

construction of marinas and harbours is severely detrimental to coral reefs because it creates large amounts of fine sediment, which smother and suffocate corals. While corals are typically capable of clearing small amounts of sand from their surfaces, they cannot remove fine silt, nor can they remove large amounts of sediment. Death can follow within hours or days of a large sedimentation event. A single dredging project to construct a canal in Bonaire caused the mortality of over half of all live corals at the 35 m depth on a nearby reef (Hof 1983).

Coastal development is invariably followed by coastal pollution. The most common form of coastal pollution is sewage released directly into the ocean or overflows, leaks, and leaching from holding tanks and injections wells on land. Sewage contains pathogenic bacteria including *Serratia marcescens* that cause deadly coral diseases (Sutherland et al. 2011). Sewage also contains nutrients (i.e. phosphorus and nitrogen molecules) which act as fertilizers on the reef, causing algal blooms, algal overgrowth, coral disease and coral death (Pastorok and Bilyard 1985, Reopanichkul et al. 2009). Approximately 80-90% of sewage discharged into Caribbean waters is discharged untreated (Jeftic 2006). Viruses in sewage have been traced over long distances in reef water, meaning that sewage affects corals reefs far from the site of its release (Futch et al. 2010). Even when sewage treatment plants are constructed, they pose a threat to coral reefs due to undertreatment, incomplete treatment, breaks, leaks, overflows, malfunctions, etc. In Curaçao, coastal development and sewage input were identified as the main causes of reef decline in Spaanse Water Baai (Debrot et al. 1998). In Kaneohe Bay Hawaii, sewage input along with construction and other source of pollution cause the death of nearly all corals between 1940 and the 1970s (Banner and Bailey 1970, Banner 1974, Stimson et al. 2001). In addition, sewage expulsion into coral reefs is a major human health risk. A representative from the consulting firm that presented the zoning plan for Oostpunt stated that a sewage treatment plant would be built at Oostpunt to treat all waste from the new development. However, there is no firm evidence (1) whether this is true, (2) where such plant would be built, and (3) if a legal obligation exists to build a sewage treatment plant at Oostpunt. The threat of deadly sewage input to the reefs of Oostpunt is a reason to immediately halt coastal development at Oostpunt.

Toxic chemical pollution in coastal runoff stresses and kills corals and leads to degradation of coral reefs. Chemical pollution in coastal runoff comes from “industries, aquaculture, and agriculture, as well as households, parking lots, gardens, and golf courses” (Burke et al. 2011). Chemicals on Curaçao that are toxic to coral reefs include but are not limited to: pesticides, insecticides and herbicides (used in landscaping and golf course maintenance), fertilizer (applied

to agricultural lands, landscaped areas, lawns, and golf courses), cleaning solutions, detergents and cleaning chemicals (used in hotels, resorts, laundry services and homes), oils, cleaners and lubricants (used in industry and construction), paints, solvents, oils, stains, sealants and thinners (especially those that are disposed of improperly), and oil and grease from automobiles, which accumulate on roadways and parking lots until they are washed away by rain or irrigation.

There is no way to completely stop all toxic chemical pollution in runoff due to the decentralized nature of toxic chemical use, the widespread nature of toxic chemical use, the manners in which toxic chemicals are used, and the widespread tendency to dispose of toxic chemicals improperly.

Although briefly mentioned above, the effects of golf courses on coral reefs should be addressed specifically in further detail. Golf course construction involves large amounts of land clearing and deforestation, producing loose soil that will runoff into reef waters, block light from photosynthesizing animals and potentially smother corals. Golf course maintenance includes application of toxic pesticides, herbicides and fertilizers. The proposed construction at Oostpunt includes three golf courses. Given the nature of the island, even fertilizer applied inland from shore will leach through the limestone basement of Curaçao and out into groundwaters and reef waters. In Abaco, Bahamas, the Baker's Bay golf course (due to both construction and later fertilizer application), is directly blamed for an increase in coral disease, algal overgrowth of corals, and an overall 30% decrease of coral cover on adjacent coral reefs in Guana Cay (Goreau et al. 2012).

Tourism itself causes irreversible damage to coral reefs. Tourists are responsible for high consumption of seafood and ongoing removal of beach curios, increasing the strain on marine resources. Beach visitors damage and trample terrestrial and coastal habitats such as estuaries, seagrass beds, and shallow coral habitats. Divers, snorkelers and swimmers cause measurable damage to reefs by trampling, touching, breaking, and running into reef organisms, including extremely-slow-growing reef corals. Even slight damage to reef corals increases the rate at which corals contract diseases and become smothered by algae. (Hawkins and Roberts 1994). In fact, it is a widely-accepted fact that tourist activities are dangerous for reefs. As Hall wrote over a decade ago (i.e., in 2001), "That tourism can cause harmful impacts on the physical and marine environments has now become well recognized (Beekhuis 1981, Archer 1985, Baines, 1987, Hanna and Wells 1992)."

It is not only direct impacts of tourists that harm reefs. Even human actions that occur far inland from coral reefs can damage them. For example, any activity that alters sediment flows to reefs (for example dust blowing and sediments flowing from recently-cleared construction areas) can kill corals and other reef organisms. Sediments kill benthic organisms by blocking photosynthetic algae, slowing growth, delivering deadly bacteria, and weakening immune systems (e.g Rogers 1990). Fertilizers delivered from shore (which contain nutrients like nitrogen and phosphorus, thus causing what is known as eutrophication) stimulate plankton blooms, inhibit the delivery of light to corals. Simultaneously, these nutrients promote the growth of the algae and seaweeds that produce toxins, harbour pathogenic bacteria, and smother/overgrow corals (e.g., Buddemeier et al. 2004). When eutrophication reaches extreme levels, dying plankton populations are consumed by bacteria, which use up all available oxygen in the seawater; this created hypoxic conditions and what are known as "dead zones," followed often by total ecosystem collapse (Selman et al. 2008, Burke et al. 2011).

In the Oostpunt Study, the Environmental and Ecological Assessment by Langan does not sufficiently include, discuss or refer to these known problems associated with coastal development on coral reefs. These key concerns are superficially glossed over at best, or ignored completely at worst. We disagree that the measures proposed by Langan, Wolff et al. (which are claimed to merely reduce sedimentation impacts) are sufficient to prevent such wide-ranging, varied, well-known, and demonstrably-deadly sources of damage to the reef.

To illustrate our viewpoint that the degree of proposed development along Oostpunt's south-western shore will lead to damage to the island's coral reefs in this area, we provide the following specific examples:

Population growth in Kaneohe Bay (Hawaii) increased ten-fold between 1940 and 1970. With this growth, coastal development included dredging and urbanization (land-clearing, paving, and construction). Kaneohe Bay suffered increases in sedimentation, chemical runoff, and nutrient input (eutrophication), which led to poor water quality, massive coral death, overgrowth of invasive algal species, and total loss of coral reef ecosystem function (Banner and Bailey 1970, Banner 1974, Stimson et al. 2001).

In Belize, Guatemala, Honduras and Mexico, the GEF/World Bank MBRS Initiative identified the main threats to the coral reefs as: "1) inappropriate coastal/island development and

unsustainable tourism; 2) inappropriate inland resource and land use and industrial development; 3) over-fishing and inappropriate aquaculture; 4) inappropriate port management, shipping and navigation practices; and 5) natural oceanographic and climate meteorological phenomena" (Almada-Villela et al. 2002).

In Hurghada, Egypt, tourist development has caused "substantial damage" to coral reefs (Hawkins and Roberts 1996). 56% of tourists to Egypt either dive or snorkel in the Red Sea (Cesar 2003) and the human activities associated with tourism have caused declines in coral cover by 30% in some places (Wilkinson 2000). This is attributed to direct contact by divers and snorkelers, land alteration, construction of artificial beaches, and sewage input from hotels. As a result, 61% of Eyptian reefs are at "serious risk" from human activity. Coral cover at Hurghada is only 29-30% of the bottom, compared to 69-75% in areas far from tourist development (Abou Zaid 2002).

In Curaçao, from 1961 to 1992, Spaanse Water bay suffered "major losses" of two important reef-building coral species. Over the same time period, another common coral species showed slower growth and higher rates of colony death. These declines in coral community function are attributed to extensive development within the Spaanse Water area (Debrot et al. 1998), especially residential construction, increased nutrient addition and sewage input into the waters. More broadly, coastal development is implicated as the main cause of reef decline in Curaçao's reefs (Bak and Nieuwland 1995).

Tourism development specifically has degraded Curaçao's marine life; Curaçao's coral reefs show "clear signs of degradation in the areas where tourism facilities are located" (Dinica 2012). Landscaping at hotels and resorts typically involves palm trees and tropical flowers that are not native to Curaçao. These require heavy fertilizer and water use, which washes into the ocean and kills coral reefs (Gast and Lapointe 1998). Artificial beaches are built for hotels to maintain a "tropical" look, but when this sand is added to non-natural beach areas, it is then washed directly onto the reef, where it kills corals (Albeelen, 1996 pp. 81-82; Debrot 1993). Hotels on Curaçao have been discharging sewage raw or partially treated onto the coral reef, killing the corals (Gast and Laponte 1998, Debrot 1993, Geleurken 2005). Tourists create more solid waste than residents of Curaçao and Curaçao's landfills "have been leaking pollutants into the soil and ocean and will continue to do so for decades" (Dinica 2012). Therefore, Curaçao is considered to have "very high exposure to reef threats" and its economic and social well-being are considered to have

"very high reef dependence." Thus, according to the World Resources Institute, which conducts a global analysis of reef threats, Curaçao is a country with "very high social and economic vulnerability to reef loss" (Burke et al. 2011). Consequently, adding to the current amount of stress experienced by Curaçao's coral reefs, especially in areas where reef persist in a healthy state, through all factors illustrated above, will lead to the irreversible loss of these unique ecosystems, and none of this is adequately considered by Langan, Wolff et al. Therefore the current process to develop the Oostpunt area should be stopped, until more thorough and accurate studies have been conducted taking the above into account.

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Overview of issues related to statements and findings related to the terrestrial environment as described in the Oostpunt Study conducted by Wolff, Langan, et al. as provided through the government's website (dated 31 May 2011) and made available at the Ministry of VVRP

Failure to complete an adequate assessment of Oostpunt's terrestrial ecosystems, landscape types and species

The field visits undertaken to compile the "environmental assessment" comprised only 5 days in early 2011.This is definitely a far too short amount of time spent in ecosystems the consultant has no expertise in. Especially because there have not been any recent field studies on populations of endemics, rare and/or endangered species in the Oostpunt area, it is essential that such study is conducted to obtain accurate and up-to-date data that can subsequently be used for any analysis, report or plan that would follow. The current "study" lacks such proper survey or monitoring effort. Secondly, while a minimal number of species was observed during the field studies, nothing is mentioned about their abundance, distribution or habitat use which is crucial data to be able to prioritize areas for conservation in the light of possible development scenarios. In short, a list of 18 species (*Buteo albicaudatus,Falco sparverius, Aratinga pertinax,Phoenicopterus ruber,Poliborus plancus,Falco columbarius, Himantopus mexicanus, Haematopus palliatus, Fregata magnificens, Ardea alba, Sterna* sp., *Larus sp.,Tyrannus* sp., *Iguana iguana, Cnemidophorus murinus*, donkey, goat, cotton-tail rabbit) and some vague description thereof is not an "environmental assessment" and therefore any future study/report based on this information lacks any form of rigorous baseline data for decision-making processes. This study fails completely to make any inference to habitat requirements of any species. This has not been done for any common or rare species. Raptors e.g. need large areas for their survival and no data are given on e.g. occurrences and numbers of the endangered White-tailed hawk (*Buteo albicaudatus*) or the endemic Curacao barn owl (*Tyto alba bargei*) or other larger bird species that need large and undisturbed natural areas for their survival (Debrot et al. 2001, Nijman et al. 2009). No reference is made to internationally and regionally endangered tern species that nest in coastal areas and the possible effects of construction of wind turbine parks, windmills etc.

No account is made of the (possible) impacts of the several project activities on other important or internationally important/endangered bird species, including flamingos and aquatic birds like duck species that use e.g. the coastal wetlands (Lagun Blanku, Awa di Oostpunt) for resting and

foraging (see e.g. Voous 1983, Debrot & de Freitas 1991, Debrot & de Freitas 1997). Furthermore, the study misses an overview of which areas (habitats/landscape types) were visited. The on-site inspections were conducted in only 5 days. Due to the enormous size of the Oostpunt area (4400 hectares) it is impossible to see all ecologically important areas (or even all areas in general, especially those not accessible via existing roads and trails. It is therefore very likely that statements based on the site visits are very biased towards more accessible and therefore less pristine sites of this area. Consequently, without additional information it is impossible to determine for which areas statements in the report are relevant.

Failure to provide information on methodologies and data sources used

The report nowhere mentions which methodologies or criteria were used to conduct terrestrial ecosystem assessment and/ or inventories. Therefore it is unclear whether the minimal amount of information was gathered in a manner sufficient to generate reliable data that can be used for potential future zoning/ planning purposes. The most important literature on local ecology and special conservation values are not considered in the" environmental and ecological assessment". Many statements are made based on popular sources, even when scientific sources on these topics exist and are readily available. Scientific reports made for the government about Curaçao's nature in general and/or the Oostpunt area are not used in the report that consequently lacks any form of insight in the biology and ecology of local ecosystems and species**.**

Failure to adhere to existing EOP principles

The proposed "zonation" of Oostpunt includes a large area that is planned for urban development. Such designation goes against existing EOP principles. The following principles apply as stated in the EOP (EOP deel 1, Toelichtingsplan (D1), par. 1.3, p. 40) and which are part of Curaçao's concentration strategy (as described in (e.g. http://www.un.org/esa/sustdev/sids/sidslist.htm, Commissie Natuurbeleidsplan Curaçao 2001) to achieve a structured and sustainable use of the island's limited spatial and natural resources: (ad 6) The island strives towards an optimization of the island's infrastructure and services already present within the existing urban areas of Willemstad. With the creation of new urban areas in Oostpunt, the government achieves dispersion dispersion of such infrastructural and services and goes against their own policy as voiced in the EOP and other official documents. This is further corroborates by their statement (i.e., bullet 7 from the EOP) where they state that there is still enough space within the Willemstad area to allocate urban development and (i.e., bullet 8 and 9) that outside of the urban areas only limited development for tourism and industry may be considered to maintain the urban

character of the other areas and to maintain present natural values. In short, with the proposed "zoning plan", the island government goes against their own policy and most important document on spatial planning, i.e., the EOP. Furthermore permitting a development so far from other developed areas will create a heavy financial burden on the community. Elsewhere in the Caribbean lack of planning and therefore uncontrolled destruction of natural and financial resources has had important negative impact on the whole society (e.g. McElroy & de Albuquerque 1998).

Failure to provide an accurate description of Oostpunt's vegetation types

In the report, five vegetative communities were identified (section 3.5) based on a 3-day site inspection in February 2011. Ironically, the Oostpunt study defined five vegetation types although they mention that they looked at an existing vegetation map of Curacao listing 24 landscape types described for the island and of which 20 are found on Oostpunt (Beers et al. 1997). Because more than one vegetation type can occur in a landscape type, the number of vegetation types that are found in Oostpunt are even higher.

Examples of missing or wrongfully described vegetation communities include: (1) The "Beach" vegetation (found all along the calm southern coastline) and the "Lithophila Lower Terrace" vegetation (found on the windy and rough north-eastern coastline). While these landscape types and corresponding vegetation types are completely different from each other (Beers et al. 1997), they were grouped as "Shoreline vegetation without any listed reason as to how this grouping came about. (2) Surprisingly mangroves were grouped with "other shoreline communities" and their ecological importance for the terrestrial and marine ecosystems of Curacao (e.g., as nesting, foraging and nursery areas) is completely ignored. Many studies have shown the importance of mangroves as nurseries and breeding grounds for ecologically important and commercial fish species (see the many publications by Dr. Ivan Nagelkerken & others) and other marine animals such as lobsters and conch (see e.g. Debrot & de Freitas 1991). This is also relevant in relation to the fact that only 0.12% of the island's surface is covered by mangroves and this area is rapidly diminishing due to coastal development. The protection of mangroves is also internationally important (See SPAW Protocol No. 3). The mangroves near the St. Joris Baai represent the second largest mangrove area on Curacao, yet again; this very important fact is completely ignored in the report. The mangroves of the Fuikbaai are also in good condition and therefore are worthwhile preserving. Mangroves play a very significant role for birds (both indigenous birds as migrant birds; Voous 1983, Prins et al. 2009): 41% of indigenous bird species make use of

mangrove areas (Debrot & de Freitas 1997). The mangroves in the eastern part of the island are critical for the survival of the rare Patagioenas squamosa (scaly-naped pigeon) (3) Approximately half of the rare Haematoxylon-Rhynchosia Terrace vegetation remaining on Curacao is found on Oostpunt (i.e., along the southern coast on the sea-facing slopes of the Seroe Domi Formation). No mentioning of this fact is included by the Oostpunt study despite the fact that much of the proposed touristic development is "zoned" in areas dominated by this vegetation type. This simply means that the development of this area was "planned" without taking the value of an impact on this unique vegetation community into account. Other characteristic and well-developed landscape types present at Oostpunt are neither mentioned nor taken into account in the Oostpunt study.

It is unclear why in the Oostpunt study a very simplified (and obviously not based on any relevant criteria for the area) representation of readily available and more accurate data on Oostpunt landscape and vegetation types was used. It is also questionable whether the researchers were even able to visit all the areas where these different vegetation types occurred during their short visit. Consequently, any rationale or data to support their use of only 5 vegetation types is completely absent or wrongly represented in the report. It can be stated further that Beers et al. (1997) provide sufficient information/data to deal with the landscape and vegetation types present in the area.

Failure to discuss important plant species

While there is a marginal (at best) table listing observed "wildlife" on Oostpunt (Table 1; Wildlife observed on Oostpunt Curaçao), similar information on all important plant species that can be found in the Oostpoint area is missing, despite the fact that a substantial amount of scientific and consultancy reports are readily available (e.g., Debrot and De Freitas (1997), de Freitas (2010)). These and other publications mention numerous important, rare and endemic plant species (e.g., *Mammilaria mammilaris*, *Opuntia curassavica* (not to be confused with *Opuntia Wentiana* (or common prickly pear)), *Sophora tomentosa* (indicator species of a littoral woodland vegetation type), *Salicornia perennis* (Oostpunt is the only location on Curaçao where this plant is still present) and many others).

In Table 2 ('List of threatened and endangered species and species of concern in Curaçao') of the Oostpunt study only a very limited number of rare plant species are mentioned. Six of the nine cacti species mentioned in the table are more common species on the island e.g. while it doesn't

mention in the area occurring plant species such as e.g, *Ficus brittonii* (mahok di mondi) and *Celtis iguanaea* (bèsh'i yuana). A number of other endemic plants are not mentioned at all (see Debrot 2006, Stoffers 1963-1984).

Failure to acknowledge important aspects of Oostpunt's vegetation in terms of species abundance and diversity clearly illustrates that this report lacks a rigorous information base on which future zoning and/ or planning studies can be based.

Given the limited amount of time that the "researchers" spent in Oostpunt (i.e., three days) their conclusion that Rare and Endangered plant species listed in their Table 2, are not present seems premature at best. Many of these species are actually present on Oostpunt and as such the authors's statement that they don't clearly shows their minimal efforts to provide a representative depiction of Oostpunt's plant communities. Another plant species (*Zanthoxylum flavum*) appears on the IUCN list Redlist as Vulnerable, yet it does not appear in the table, again illustrating the fact that the authors failed at even the simplest forms of information gathering on this topic.

Failure to use available data on landscape and vegetation types and presence of rare plant species for impact evaluation and decision-making

There are numerous scientific publications that provide scientific methods for prioritizing areas for conservation. Criteria include e.g. occurrences of rare plant species and the occurrence of areas of rare and/or characteristic vegetation types. The Oostpunt study fails on both ends. It does not take into account the presence of the very rare tree species *Zanthoxylum flavum* on Seru Blanku and designates this area for urban development. *Zanthoxylum flavum* appears on the IUCN list Redlist as Vulnerable, yet it does not appear in Table 2 of the Oostpunt study, again illustrating the fact that the authors failed at even the simplest forms of information gathering on this topic.

With respect to the occurrence of characteristic and unique vegetation types the Oostpunt study has not considered the occurrence of e.g. the *Haematoxylon-Bourreria* terraces, a very rare landscape and vegetation type that almost exclusively found at Oostpunt (Beers et al. 1997). Also the only areas with a *Tillandsia flexuosa* vegetation type in the eastern half of the island of a will be destroyed should "zoning" occur as proposed in the Oostpunt study. The failure to acknowledge of the role of characteristic or rare vegetation types and presence of rare plant species is clearly illustrated by the following sentence in the Oostpunt study, where "conservation

areas" are simply regarded as a "dump-category" for areas lacking real estate value: "In the lower areas of the site, where views are limited and higher real estate values may not be achieved, we feel these are best suited for the lower density rural habitation, agriculture, golf, open lands and conservation."

With respect to rare plant species the Oostpunt study fails to include data on species abundance and diversity and distribution. In Table 2 ('List of threatened and endangered species and species of concern in Curaçao') of the Oostpunt study only a very limited number of rare plant species are mentioned. Six of the nine cacti species mentioned in the table are more common species on the island e.g. while it doesn't mention in the area occurring plant species like *Ficus brittonii* (mahok di mondi) and *Celtis iguanaea* (bèsh'i yuana). A number of other endemic plants are not mentioned at all (see Debrot 2006, Stoffers 1963-1984).

Overall it can be concluded that the Oostpunt study fails to acknowledge important aspects of the landscape and vegetation types of the Oostpunt area as well as inclusion of important rare plant species and therefore the report lacks a rigorous information base on which zoning and planning studies can be based.

Failure to adequately describe invasive plant species

Acacia tortuosa is suggestively mentioned as an invasive species (3.5.2 Invasives). *Acacia tortuosa* (Wabi (PAP.)) is NOT an invasive species. (see e.g. the Global Invasive Species Database (www.issg.org) and Kairo et al. 2003). It is a pioneer species that grows first after a piece of land is cleared. The presence and abundance of *Acacia tortuosa* indicate the presence of recent disturbance (land clearance and/or intensive grazing) and is a characteristic species of an early succession stage the islands vegetation. In the most comprehensive description of invasive plant species on Curaçao (Van den Burg et al (2012); freely available at wordpress.iworklab.com/dcna/wp-content/uploads/2012/08/C185-11-InvasiveplantsBurghFreitasDebrotLotz.pdf), *Acacia tortuosa* is not listed as an invasive species. Again, Langan completely fails at gathering even the simplest forms of information and misrepresents important information about this abundant plant species by falsely defining it as an invasive species (probably because it grows fast in disturbed areas, which characterizes this species simply a pioneer species, not an invasive species. Weirdly enough, a reference on this species (Francis, J. K. *Acacia tortuosa* (L.) Willd.) is included in Langan's reference list, but

nowhere mentions *that Acacia tortuosa* is invasive again illustrating the authors inability to gather data and adequately describe ecological characteristics of the Oostpunt area.

Failure to adequately identify, protect and buffer the gullies/swales within the area

Again, the available scientific literature on the geology and hydrology of the Oostpunt area is largely ignored. The entire watershed paragraph (3.2) is void of references to any literature treating hydrology in the area or the island in general. Subsequently, there is no methodology describing how data and criteria were used, gathered or created to substantiate the proposed buffer zone (50m on both sides of the centreline of the corridor) alongside the drainage corridors. These strips of conservation areas have therefore apparently been taken for convenience (a developer cannot build anything in them) and we are not aware of any scientific study that has shown that in order to buffer gullies an area of 50m on both sides of the center line is necessary. On the contrary Hudson (1991) states that buffer zones should be 1.2 km wide because corridors should be more than the provision of passage to certain animal species. Corridors should be wide enough to be able to accommodate the 'slower movements of biodiversity (genes, communities & processes)' (Ministerie van Landbouw, Natuur en Visserij (LNV) 1990, Hudson 1991, Ahern 1995). The monitoring of processes taking place in the area would be necessary in order to ensure indicating an adequate width of the corridors. This would need more than 5 days in the field.

Secondly, the study does not indicate any buffer zones for any other landscape types in Oostpunt nor discusses how the Oostpunt study has taken in consideration the important landscape types present in Oostpunt. The area is home to 20 of the total of 24 different landscape types present in the area. The Oostpunt study states that the watersheds were identified during site visits and through analysis of recent satellite imagery. The Oostpunt study doesn't mention which proxy or other identification method is used to determine the current gullies from the satellite imagery. Besides available detailed drainage maps of the area in e.g. Beets (1972), a GIS-simulation of the hydrodynamics was perfectly possible based on the GIS elevation data, past rainfall data and hydrological characteristics of geological formations within the Oostpunt area, to determine impact of e.g. heavy rainfall (an aspect that cannot be determined by mere satellite picture analysis), yet again neither can be found in the report. Not taking the detailed pattern of water flow in the area will have serious consequences for the ecology of the area (e.g. increased erosion, increased sedimentation on the reefs resulting in loss of ecosystem services provided by this system as well as economic loss). This omission will also cause other ecological damage: distortion of the natural water flow patterns combined with urban development and disturbances

in the surrounding areas will result in serious (irreversible) damage to soil properties (Albaladejo et al. 1998; Pueyo et al. 2006). The study of possible effects of urban and other developments on water flow and hydrology of the area would have been expected considering the effect that Oostpunt is characterized by large areas of subterranean caves with fresh water. These subterranean freshwater systems contain unique and rare invertebrates that also serve to give insight into the geological past of the island (Stock 1977). The Oostpunt study speaks of buffering "mature vegetation" which has been measured during site visits, but again there is lack of description of what is meant by "mature vegetation" and where the measurements have been done and what their criteria were to distinguish mature vegetation and how this relates to the landscape ecological vegetation color map of Curacao (Beers et al. 1997). So the basis used to determine the extent of the buffer zones is unscientific. Another failure is the fact that the buffer zone begins at the centre of a gully (or drainage corridor) irrespective of its width.

This inevitably results in mature vegetation buffer zones narrower than the 50m indicated in the text, especially at locations where gullies become wider. Normally buffer zones are created around a valuable area or ecosystem. These valuable areas ('core/centre zones') are then buffered to mitigate or minimize the so-called "edge effects". In this report the so called buffer zone start in the middle of the gully, so in effect there is no buffer zone.

The area is home to 20 of the total of 24 different landscape types present in the area. The Oostpunt study states that the watersheds were identified during site visits and through analysis of recent satellite imagery. The Oostpunt study doesn't mention what method was used to determine the gullies etc. from the satellite imagery and ignores available detailed drainage maps of the area in e.g. Beets (1972). A GIS-simulation of the expected hydrodynamics of Oostpunt is theoretically feasible and relatively easy by combing GIS elevation data, past rainfall data and hydrological characteristics of geological formations within the Oostpunt area, but is not included in the report despite the great attention put on watershed dynamics and characteristics. Failure to adequately address the area's hydrodynamic characteristics leaves all speculation in the Oostpunt study on areas potentially suitable for development unsubstantiated and unfounded. Proposed development in hydrodynamically sensitive areas will have serious consequences for the ecology of the area (e.g. increased erosion, increased sedimentation on the reefs), and result in serious (irreversible) damage to soil properties (Albaladejo et al. 1998; Pueyo et al. 2006).

A study of possible effects of urban and other developments on water flow and hydrology in the area should have been conducted but is currently lacking in the Oostpunt study. Oostpunt

harbours a large number of subterranean caves (sometimes with fresh water) that contain unique and rare invertebrate fauna, provide insight into the geological past of the island (Stock 1977) and generally render such areas unsuitable for construction due to bottom instability.

The Oostpunt study speaks of buffering "mature vegetation" encountered during site visits, but no description of what is meant by "mature vegetation" is included in the Oostpunt study. No information is included where "measurements' were taken, which criteria were used to define "mature vegetation" and how this vegetation type relates to the existing vegetation map of Curaçao (Beers et al. 1997). In sum, the absence of all aforementioned data sources renders the proposed placement of buffer zones subjective at best.

Failure to include or take into account basic principles regarding ecosystem integrity and related threats

The level of habitat fragmentation caused by the proposed "zoning" in the Oostpunt study will result in a serious impoverishment of the ecological values and services currently present in the area. Habitat fragmentation is primarily responsible for losses of local biodiversity (e.g. Harris & Silva-Lopez 1992, Schwartz 1999, Boyd et al. 2008). Habitat fragmentation also invokes so-called edge effects (Laurence & Yensen, 1991) where outward edges of seemingly protected areas (such as the proposed conservation areas) are significantly impacted from activities and dynamics in nearby less protected areas. This reduces the effectiveness of proposed conservations areas as the areas where natural dynamics can proceed in an undisturbed manner are smaller than projected in the Oostpunt study. Generally, this is why zoning plans include buffer zones, i.e., to reduce such "edge effects". The edge effects (which are nowhere discussed in the Oostpunt study) also lead to weaker and less resilient populations and facilitation of feral and invasive species, a reduction of microclimatic niches, etc. The lack of such information in the Oostpunt study renders it unsuitable for future planning/ zoning purposes.

The conservation zones are largely planned along escarpments and drainage corridors. Therefore, most of these conservation areas are largely functionally placed without consideration of animals or plants that require protection within conservation areas. "For example, many endemic and endangered species such as the Scaly-naped pigeon, the White-tailed hawk, the Barn owl, etc. will lose (one of) require larger and undisturbed areas for their survival (Nijman et al., 2009), but the placement of conservation areas nowhere includes such considerations. Ironically, most conservation areas are placed in areas unsuitable for construction and/ or development and as

such we fear that conservation areas were largely defined as areas "left over" after assigning suitable developable areas, rather than chosen on ecological grounds.

Thus, the Oostpunt study completely fails to address what the effects of the fragmentation resulting from the proposed development of Oostpunt will be to on population persistence of important species in the Oostpunt area in particular but also on Curaçao in general.

Failure to consider unique and rare geological characteristics of Curaçao

Geological characteristics of the area have been totally ignored in the Oostpunt study and all unique geological formations in the area will become destroyed when the Oostpunt area becomes "zoned" as proposed in the Oostpunt study. Klaver (1987) mentioned that Oostpunt is unique for the picrite basalts, found only in the central part of Oostpunt. Beets (1972) indicates the presence of two exceptional geological formations from the Eocene period (55 million years ago) at Seru Blanku and Ser'i Mainshi. The geology of this period is barely investigated and thus is best conserved in its original state. Both of the latter areas have been destined for urban development in the Oostpunt study, thus illustrating the authors' inability to find relevant information, lack of scholarly ability and/or effort at Langan and shows that recent and widely-available (relevant) information was not included in their Environmental and Ecological Assessment.

Failure to adequately consider endemic mammals and reptiles

The endemic mammals and reptiles are all mentioned on a paragraph named "Common", creating the illusion that at least most of the mentioned species are common. This is not the case. 4 of the 8 bat species appear on the IUCN Red List (most of which the population trend is unknown) and have very small populations on Curaçao (see e.g. Petit et al. 2006) and include endemic subspecies for Curacao (Debrot 2006). Other endemic animals are not mentioned at all. A total of 141 endemic animals are mentioned by Debrot 2006, including arachnids and insects (40 sp. + 4 ssp.), freshwater and subterranean crustaceans (25 sp. + 3 ssp.), freshwater polychaets, flatworms, rotataria (7 sp.), terrestrial gastropods (15 sp. + 5 ssp.), fresh/brackish water fishes (2 sp. + 1 ssp.), reptiles (9 sp. + 3 ssp.), birds (22 ssp.), and mammals (1 sp. + 4 ssp.) (see e.g. Debrot 2006). Therefore the Oostpunt study once again fails at adequately the status of important ecological elements of the Oostpunt area and as such cannot be used for subsequent "plans" based on this study.

Failure to provide details on bat study

Statements made about the bat survey mentioned in the Oostpunt study lack any form of information to determine whether this study was correctly conducted. They solely focus on the potential detrimental effects of wind turbines on bats, but not on the role of bats as key stone species that ensure pollination of cacti across Curacao, whose fruits are then food for an enormous amount of animals during the dry season. Consequently, without cacti a large number of animals would be unable to survive on Curacao. Secondly, the authors' methodology is likely insufficient to support their conclusions drawn. For example, we don't know e.g. how long the bat detector was used, and which of the nine bat species known for the island have been detected and how their habitat use was determined if researched at all (this type of research would require a much longer period of time to do in a professional manner). Because "measurements" were only made on one night, natural variability in flight distance (and therefore Important bat habitat areas), bat abundance, species composition, foraging/hunting behaviour, etc. could not be assessed and conclusions drawn are hence based on a "glimpse" of these important species' behaviour and dynamics. Again, the study fails at adequately describing and appreciating the role and importance of certain species (in this case bats) in the Oostpunt area. Scientific bat research on Curacao has shown that bats will use certain habitats depending on food availability. This research has also shown that certain bat species are not detected at all with sophisticated ultrasonic equipment. Therefore their presence can only be detected by visual inspection. No information is provided on the importance of habitats for these animals that are critical in the islands' ecosystems and this is not surprising considering the fact that they only spent one evening in the field looking for bats. Nothing is mentioned either with respect to important habitat for the also internationally threatened nectar-feeding bat *Leptonycteris curaosoae curasoae* (see e.g. Petit et al. 2006). Therefore the Oostpunt study once again fails at adequately the status of important ecological elements of the Oostpunt area and as such cannot be used for subsequent "plans" based on this study.

Failure to acknowledge habitat requirement of important bird species

The habitat use and size of important and (locally rare) endangered bird species is not mentioned. This point is very important, because one of the important reasons to keep the area of Oostpunt as a large unfragmented natural area is because certain bird species need large natural areas for their survival (Voous 1983, Debrot et al. 2001, Nijman et al. 2009). Nijman et al. (2009) conclude that ongoing urbanization on Curaçao has caused a decline in the small and endangered White-tailed hawk and Caracara populations of the island. This situation furthermore increases the importance

of maintaining the biodiversity of large undisturbed natural areas like Oostpunt. Raptors e.g. need large areas for their survival and no data are provided in the Oostpunt study on e.g the presence and numbers of the endangered White-tailed hawk (*Buteo albicaudatus*) or the endemic Curacao barn owl (*Tyto alba bargei*) or other larger bird species that need large and undisturbed natural areas for their survival (Debrot et al. 2001, Nijman et al. 2009).

Ammadrommus savannarum one of the rarest bird species on the island and with a preference for the northern coastal areas is not mentioned at all in the Oostpunt study nor the possible impacts of the proposed constructions (wind turbine park, golf courses and other related tourism infrastructure) on the populations of this endemic bird species (Voous 1983, Prins et al. 2009).

No reference is made on the possible impacts of the proposed construction of wind turbine parks, golf courses and related tourism activities/infrastructures on these internationally and regionally important bird populations as well as the other bird species mentioned above. One of the sites in Oostpunt at which the regionally important Antillean tern (*Sternula antillarum*) was found harbours one the three largest populations of this bird species of the island. All three of the largest populations are in undisturbed areas like Oostpunt (Debrot et al. 2009). Neither nothing is mentioned on the possible impact of coastal tourism development in the coastal areas to the west of Landhuis Klein St. Joris on the very important bird sanctuary of Isla Makuaku in the St. Jorisbaai. This islet is a breeding site of the internationally endangered Common tern (*Sterna hirundo*) and was the first site on the island to be declared as a seabird sanctuary (DROV 1985). The very important ecological functions of this islet are already suffering from disturbance due to increased uncontrolled recreational activities (Debrot et al. 2009). Therefore the Oostpunt study once again fails at adequately the status of important ecological elements of the Oostpunt area and as such cannot be used for subsequent “plans” based on this study.

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Some shortcomings of the Wolff et al. and KPMG studies in regards to economic values of environmental resources and long-term economic benefits

The planning study and economic impact study fail to account for ecosystem services and their values

Development near high-value environmental resources typically decreases the value of the ecosystem services provided by these resources. Therefore, a thorough development plan will account for the extant value of ecosystem services and the projected increase or decrease in value that would occur with development. As an example of direct ecosystem values, intact mangrove forests along the Pacific coastline of Mexico are valued at USD$37,500 per hectare per year due to the increased fisheries productivity offshore that is a direct product of the juvenile fish habitat in intact mangroves. This value, which quantifies fisheries productivity alone, is over 300 times higher than the price at which the Mexican government previously sold land to developers (Aburto-Oropeza et al. 2008). For tropical coastal ecosystems, ecosystem services that provide direct and indirect economic benefits include but are not limited to: shoreline protection, erosion prevention, water supply regulation, sediment trapping, food production, cultural values, aesthetic values, endangered species habitat, juvenile species habitat, larval production, ecosystem stabilization, climate stabilization via carbon storage, scientific research values, and opportunities for pharmaceutical/drug discovery.

The failure of KPMG to acknowledge ecosystem values is apparent in the following sentence from their Economic Impact Study: “The categories conservation area and open land do not have any impact for the EIS, as no development will be undertaken in these areas” (KPMG EIS p. 22). The failure by Wolff, Langan, et al. to consider impacts of development on ecosystem services in the Oostpunt Study and the failure by KPMG to consider or calculate any ecosystem service values in their Economic Impact Study effectively render both studies useless. Because the loss of asset value that would be incurred on Curaçao’s natural resources by the development plan is completely unknown, this value cannot be compared to the projected benefits of development.

The economic impact study falsely predicts permanent and stable long-term economic benefits

The Economic Impact Analysis by KPMG forecasts the expected increase in expenses for the Curaçaoan Government due to infrastructure investments at ANG 6.4 Billion in total, spent between 2016 and 2032. The study also projects that the permanent “direct added value” of

Oostpunt development will reach a stable maximum of ANG 225 Million per year beginning in 2036 (KPMG EIS, Figure 9.3, p. 37). The graph used to present this forecast ends at 2052. This forecast fails to account for the known decreases in long-term tourism income and natural resource asset value that are seen when tourism pressure near coral reefs is increased (Cesar 2003, Cesar et al. 2003). Instead, KPGM predicts a "permanent spending impulse from tourists and new residents" (KPMG EIS, p. 36) and states that the "*permanent* direct added value of Eastpoint (after the construction phase) will be in the range of 4.4% of GDP" (KPMG EIS, p. 36, italics in original text). KPMG thus provides a misleading estimate of long-term benefits by omitting the long-term declines in asset value and tourist visits that will result from the degradation that tourism pressure causes to coral reefs. The long-term damage to Curaçao's natural resources and hence the long-term damage to its economy are not included at any point in the report from KPMG.

The economic impact analysis promises false environmental and economic benefits as "catalytic impacts"

The Economic Impact Study by KPMG states that development of Oostpunt will have economic benefits beyond those projected, including "cataclytic benefits." Among the catalytic benefits listed, KPMG states that development of Oostpunt will "increase the awareness for sustainability/environment and help to preservation of natural and cultural heritage" (KPMG EIS, p. 5, grammatical error is in original document). As described above in the current document, the planned development is extremely likely to degrade the quality of natural resources on Curaçao and will thus degrade the net present value of Curaçao's natural resource assets. KPMG has falsely claimed that Oostpunt development will somehow increase environmental preservation.

Additionally, KPMG includes "Water activities" among the "catalytic benefits" that will have a positive economic impact (KPMG EIS p. 46). As we describe above, increased tourism activities (including water activities such as scuba diving) are known to degrade ecosystem quality and thus reduces tourism revenue over the long term. KPMG falsely includes the "considerable potential for expansion of the scuba dive sector" as a projected "catalytic benefits" for Curaçao rather than correctly projecting the long-term decline in scuba sector revenue and natural resource asset value that will result from development and subsequent high tourism pressure at Oostpunt.

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