

Case study

Prepared for Global Water Partnership in the course of the training course on Integrated and Adaptive Water Resources Planning, Management, and Governance

Collaboration and enforcement: the missing pieces of the puzzle in managing the Graeme Hall Swamp in Barbados

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1 Introduction

The island of Barbados is situated at latitude 13° N and longitude 59° W and is the most windward of the Lesser Antilles island chain. It is a small coral limestone island, 34 km long and 23 km wide, having a total area of 432 km². The limestone formation gives the landscape a gently undulating appearance divided by deep gullies and a series of near-vertical cliffs. These gullies, which run from the central highland towards the coastline, form the island's basic drainage system. Despite substantial annual rainfall, most of the rivers in Barbados are dry due to the permeable nature of the karst terrain. As a result, the island relies heavily on ground water as its primary source of potable water (Brewster and Mwansa 2001).



Figure 1 Google Earth Imagery of Barbados and the Wetland under consideration

1.1 Description of the Watershed

The Graeme Hall Watershed, located in the south of Barbados, spans 1,156 acres. The most significant element of this watershed is the Graeme Hall Swamp, situated in Worthing, Christ Church. The swamp covers 91 acres, divided by a causeway into an eastern and western section. The 56-acre, eastern section is owned by the Barbados Government while the remaining 35 acres is privately owned and under the management of the Graeme Hall Nature Sanctuary (GHNS). Amity Lodge, a residential development is situated on the northwest boundary of the swamp and the northern boundary borders the southern side of the Ministry of Agriculture's experimental fields (Daisley 2007).



Figure 2 Graeme Hall Watershed Area (1,156 Acres) (Wallace and Pryor 2010)

1.2 Importance of the Ecosystem

The Graeme Hall Swamp is an important ecosystem to Barbados with several distinctive features. The swamp is linked to the St. Lawrence Lagoon and is the country's last remaining coastal wetland. It houses the largest perennial surface water body of inland water on the island, in the form of a 12-acre lake, and contains the largest remaining area of red mangrove (*Rhizophora mangle*) and white mangrove (*Laguncularia racemosa*) woodland. The wetland has been designated as a Natural Heritage Conservation Area and has also been established as one of two Caribbean Coastal Marine Productivity Programme (CARICOMP) monitoring sites (see Figure 2) in Barbados (Inniss and Brathwaithe 2007).

The wetland is the only location on the island where a mangrove forest, a sea grass bed and a shallow, near shore, hard coral reef can be found in such close proximity to each other. Due to its uniqueness, it has been referred to as a "living laboratory" for researchers and scientists. The swamp also serves as a habitat or rest stop for a wide variety of animals such as the African green monkey, mongooses, bats, fish, molluscs and crustaceans. With records of at least 84 bird species, the wetland is home to the widest diversity of resident and migratory birds on the island, including locally threatened species such as the Caribbean Coot (*Fulica caribaea*) and the Yellow Warbler (*Dendroica petechial*), which are both protected by the Wild Birds Protection Act Cap.398. In addition, endangered migrant birds such as the Peregrine Falcon (*Falco peregrinus*) have also been recorded (Inniss and Brathwaithe 2007, Williams 2008).

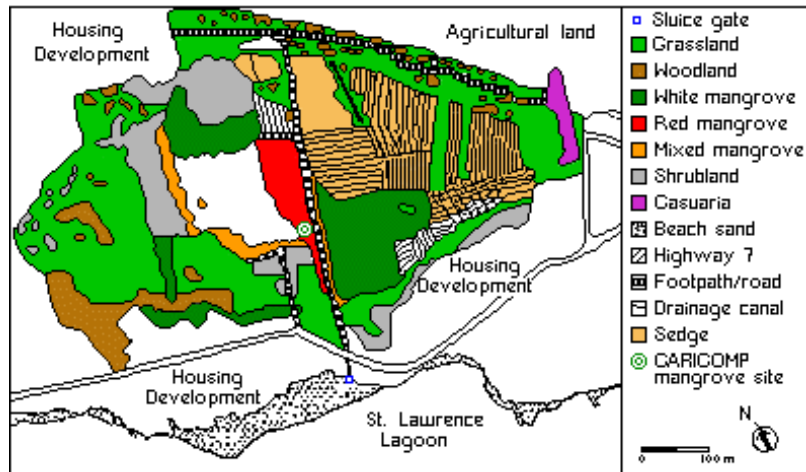


Figure 3 Habitat Map of the Graeme Hall Wetland ((Parker and Oxenford 1998)

The total value of the ecosystem may be summarized by the following table:

Table 1 Value of the Ecosystem

Use Values		Non-Use Values
Direct Use Values	Indirect Use Values	Existence Values
Recreation	Flood control	Biodiversity
Tourism		Cultural and heritage Value
Education		Bequest values (value for future generations)

2 Current State of the Watershed

2.1 Social, Economic, Environmental and Technical Aspects

Within the Graeme Hall Watershed there are the following sources of economic, social and environmental concerns:

1. The Graeme Hall Nature Sanctuary (GHNS) owned by Graeme Hall Nature Sanctuary Inc.: This privately owned sanctuary maintains the western portion of the wetland offering visitation services to the general public. Given the man-made stresses on the ecosystem, the GHNS found it necessary to close its doors to the public in March 2009. The Sanctuary is heavily dependent on the health and maintenance of the ecosystem in order to provide its visitation and education services (Wallace and Pryor 2010).
2. Private pasture lands, west of the GHNS;
3. Residential Communities of Amity Lodge and Rendezvous surrounding the wetland;
4. An Environmental Buffer along Escarpment, Rendezvous Ridge held by the Ministry of Agriculture and Rural Development, Barbados Agricultural Development and Marketing Corporation (BADMC);
5. Agricultural Lands adjoining the ABC Highway;
6. Agricultural Lands held by the BADMC, inclusive of the Barbados Water Authority (BWA) South Coast Sewerage Treatment Facility; and
7. Ministry of Agriculture and Rural Development Complex and farm lands, east of the residential communities of Rendezvous and Amity Lodge and west of the Highway 7 Roundabout at Graeme Hall.

The Research Station of the Ministry of Agriculture is responsible for the cultivation of about 97 acres of land to produce such crops as potatoes, corn, cassava, pumpkin, sweet/hot peppers, onions, beans, cotton and carrots (Williams 2008).

2.2 Main Problems, Issues and Conflicts

There are a number of factors adversely affecting the wetland. The swamp ecosystem has become isolated from the sea and has evolved from an interactive estuarine system to a drainage system. This isolation has grown gradually, mainly due to commercial beach-front development, the construction of the coastal highway and significant beach growth over time. As a result, the once numerous connections to the sea have been reduced to a single channel controlled by a sluice gate to regulate flow and tidal exchange. Nutrient-rich runoff from the nearby agricultural lands have caused a significant overgrowth of the red mangrove plant. This fact, coupled with a build-up of silt deposits have resulted in the blockage of several channels and culverts used to manage flow in and out of the area.

To further compound the issue, the sluice gate has now been rendered inoperable due to inadequate maintenance and complaints from nearby beach-goers questioning the quality of the water entering the sea. In addition, there has been evidence of illegal dumping in the area (Inniss and Brathwaithe 2007). The main issues reported have been expanded on below.

2.2.1 Inflows of Untreated Storm water, Agricultural, and Commercial Runoff

The existing buffer zone offers some degree of protection to the wetland, however there is no legislation governing the use of the land surrounding the wetland (Williams 2008). Storm events carry runoff from the surrounding residential, commercial, and agricultural activities, as well as schools and highways into the wetland. Each type of land use produces different pollutant loads. The repeated dosing of urban and agricultural runoff into a system that cannot discharge regularly to the sea ultimately leads to a concentrating effect of pollutants in the water column and sediments of the lake, pond, and canal system. The agricultural run-off is leaching nitrates and phosphates into the wetland, primarily the eastern section, thus propagating extensive overgrowth of red mangrove resulting in blocked drainage canals.

2.2.2 Emergency Raw Sewage Discharges into the Lake System

As a result of a system failure in July 2005, the BWA management authorized a major dump of raw sewage into the wetland (Burke 2007). GHNS representatives were unable to determine the precise volume of the emergency discharge; however, the discharge of effluent was enough to cause visible contamination to all water bodies within the sanctuary. According to reports made by the GHNS, the wetland is still under threat of the potential discharge of raw sewage from the treatment facility (Graeme Hall Nature Sanctuary 2009).

2.2.3 Curtailment of Seawater Interchange

The main drainage channel has been significantly reduced as a result of the sedimentation and vegetation overgrowth that has occurred. The end of the channel is currently blocked by the Ministry of Public Works due mainly to the inoperable sluice gate which controls the flow of water from the swamp to the sea. This lack of exchange between the swamp and the sea has resulted in increased sediment loading, coliform counts, biological oxygen demand and chemical oxygen demand upon release. Also, a 77% reduction in the water's salinity from 8.4 ppt in 2002 to 1.9 ppt in 2010 has been realised. In addition, the longer the

water is stored in the swamp the greater the negative socio-economic impact on nearby sea-bathers when it is finally released due to its colour and odour. Without reconnection to the sea, the eventual loss of the wetland's mangrove ecosystem, including its wading bird community, can be expected (Inniss and Brathwaite 2007, Walker 2008, Wallace and Pryor 2010).

2.2.4 Frequent Poaching

There is widespread evidence of illegal poaching within the wetland. Intruders to the GHNS were caught on camera after killing crabs and terrifying rare bird species. Prior to this, a group of fishermen were found in the GHNS illegally fishing for rare species (Graeme Hall Nature Sanctuary 2009, 2010).

3 Decisions and Actions Taken

3.1 International Treaties

There are a series of international legal and policy initiatives to which Barbados has become party to. These provide some level of protection for the Graeme Hall Wetland (Inniss and Brathwaite 2007):

The RAMSAR Convention on Wetlands of International Importance

This intergovernmental treaty adopted on February 2, 1971 covers all aspects of wetland conservation. Under this treaty all Contracting Parties must include wetland conservation considerations through the concept of "wise use" into their nation land use planning. The Graeme Hall Swamp was designated a RAMSAR site on December 12th, 2005 (The Secretariat of the Convention on Wetlands 2016).

The Convention on Biological Diversity (CBD)

CBD was open for signature at the UNCED Earth Summit in 1992. It is the largest environment convention with the following three primary objectives:

1. Conservation;
2. Sustainable use; and
3. Fair and Equitable sharing of benefits from utilization of genetic resources.

Barbados is listed as having signed the convention on June 12th, 1992 and ratified on December 10th, 1993 (Secretariat of the Convention on Biological Diversity sd). The Barbados regularly reports on biodiversity conservation and management practices as required by the CBD rules. The most recent of which, listed on the CBD's website, is the Fourth National Report which included the Graeme Hall Swamp as a case study noting its importance and the pressures it faces from surrounding developments (The Natural Heritage Department, Ministry of Environment and Drainage 2011).

The Convention on International Trade in Endangered Species (CITES)

CITES is an international agreement between governments which aims to ensure that international trade in wild plants and animals does not threaten their survival. It provided a framework for the country to adopt its own legislation for implementation at the national level.

The Cartagena Convention and two of its Protocols – Specially Protected Areas and Wildlife, and Land-based Source of Marine Pollution (SPAW & LBS)

Adopted in Kingston, Jamaica, the SPAW Protocol utilised an ecosystem-based approach to conservation with the aim to protect rare and fragile ecosystems and habitats. The LBS Protocol speaks to the prevention, reduction and control of marine pollution from land based sources and activities.

3.2 National Legislation

The National Physical Development Plan (PDP)

The PDP designated Graeme Hall as a Natural Heritage Conservation Area, protecting the wetland itself from extreme development. The PDP was amended in 2003 to provide a vision for the future growth and development of the nation to the year 2010 by setting out policies to guide relationships among land uses, community facilities and physical infrastructure (Government of Barbados 2003).

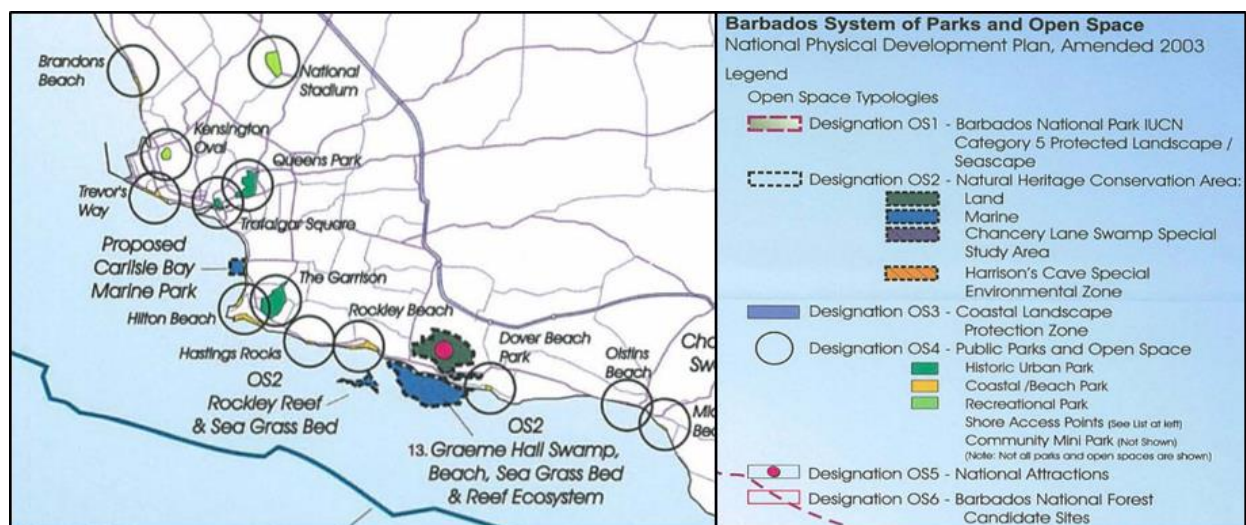


Figure 4 Map 6 of the PDP identifying Graeme Hall Swamp as a Natural Heritage Conservation Area (Government of Barbados 2003)

The National Biodiversity Strategy and Action Plan (NBSAP)

The NBSAP was intended to define the state of biodiversity and threats to the country and strategies designed to conserve biodiversity and sustainable use. The Graeme Hall Swamp was specifically mentioned in the NBSAP with recommendations for research, management techniques, legislation, incentives, benefits sharing and public education. The most notable of these recommendations included (Government of Barbados 2002):

- Allocating additional government funds for biodiversity conservation and management;
- Encouraging cooperation between local Governmental and Non-governmental agencies to reduce duplication of activities and encourage more efficient information sharing;
- Establishing a national Research Programme to document the status of, threats to and value of, biodiversity;
- Revising, consolidating and formulating policy and legislation to achieve the conservation and sustainable use of biodiversity; and
- Conducting community workshops on biodiversity conservation and sustainable use.

The Coastal Zone Management Act, 1998-39 and Plan (CZMA & CZMP)

The CZMP includes a Policy Framework and Integrated Coastal Management Plans for the coasts of Barbados. It provides guidelines for the management of the coastal and marine areas of the country. The CZMP established the Graeme Hall Wetland as a Biodiversity Reference Area and recommended that the ecosystem be designated as a restricted area under the Coastal Zone Management Act for the following purposes (Ministry of Housing, Lands and Environment 2003):

- The preservation or enhancement of the natural beauty of the area;
- The protection or rehabilitation of flora and fauna found in the area;
- The protection of items of archaeological and historical interest found in the area;
- The promotion of the enjoyment by the public of the area; and
- The promotion of the scientific study and research in respect of the area.

The Marine Pollution Control Act, 1998-40 (MPCA)

The MPCA was enacted by the Parliament of Barbados to prevent, reduce and control pollution of the marine environment from whatever source. It covers all manners of waste disposal and discharges in Barbados which may impact the quality of water and marine ecosystems.

3.3 Research, Education and Public Awareness

The GHNS has funded several studies on the watershed to quantify the impacts of land use on the quality of life in the ecosystem, as well as the value of the wetland to the country, its people and its economy. In addition, the Government of Barbados (GoB), has conducted several studies on the area establishing the need for a “Master Plan for the Graeme Hall Swamp and Associated Coastal Ecosystems”.

Given the general lack of publicized information on the wetland, there was need to inform the community of the value of the ecosystem and consequences of its mismanagement. The officials of the GHNS have published several reports and articles, via their website and on social media, on the state of the wetland, its importance and value to the local community and recommendations for its restoration. Within these publications, there is evidence of several attempts by the Sanctuary to gain the support of the Government of Barbados in maintaining the wetland.

4 Outcomes of Decisions and Actions Taken

The current actions are somewhat consistent with an *Integrated and Adaptive Water Resource Management* (I/AWRM) approach, in that the legislation and policies established do offer some level of protection to the wetland. This is mainly seen by the Government of Barbados’ action to establish the wetland, in theory, as a *Natural Heritage Conservation Area* and *Biodiversity Reference Area*, recognizing it as the last remaining of its kind on the island. Similarly, the research and public awareness initiatives promoted stakeholder participation and collaboration, which are key to the success of I/AWRM. This was made evident in 2007, where over 6,000 Barbadians signed a “Friends of Graeme Hall” petition in support of transforming the wetland into a 240-acre National Park.

However, without the enforcement of legislation and policies established, the wetland is still under the threat of pollution via contaminated surface runoff and illegal dumping. Likewise, the petition alone was not enough to prompt Government to enforce the legal instruments due to the complexities and existing challenges of balancing the wetland's needs with the competing demands of its environs. Furthermore, the economic implications of enforcing these regulations could be seen as significant. A detailed assessment of costs would require that, at least, the following be considered:

- The impact on tourism in the area (discharge from the swamp into the sea);
- The cost of repairing the sluice gate;
- The cost of dredging/clearing/maintaining the blocked areas of the swamp;
- The cost of finding an alternative emergency sewage discharge location; and
- Other indirect costs associated with the general manpower required to police the area.

Without the necessary enforcement, the current actions taken (though significant), have not resolved the problems facing the wetland; as (Walker 2008, Graeme Hall Nature Sanctuary 2009):

- There is still no exchange between the wetland and the sea;
- There are no adequate buffers to mitigate the effects of storm water from nearby residential, commercial and agricultural areas on the quality of water in the wetland; and
- There is still the threat of effluent discharge into the wetland from the nearby sewage treatment plant, given an emergency situation.

There is clear need for a holistic approach to the management of the watershed. This would require the major stakeholders, the Government of Barbados and the GHNS, to work together to develop sound, mutually beneficial solutions to the above-mentioned problems.

5 Lessons Learned and Recommended Actions

As landownership of the wetland and its environs is shared between the GHNS and the Barbados government, there is need for collaboration and the development of a shared, bought into vision for the watershed's future. The GHNS stated that it had invested over \$35 million in efforts to restore the wetland. However, there is very little more that can be done without the political will to support their conservation efforts. The established legislation and policy initiatives currently set the foundation for the protection of the wetland; however, given the rate at which the ecosystem is deteriorating, there is a critical need for the enforcement of these regulations.

Additionally, in the past, the GHNS has accused the Barbados Government of mismanagement of the ecosystem and criticized the various departments involved. This, together with the discharge of waste by the BWA into the wetland and the inadequate maintenance of the vital connection between the wetland and the sea, has created tension between the land-owners.

To conclude, from the review of existing literature surrounding the wetland, the root cause of its deterioration may be seen as a lack of a coordinated land-use and water resources management approach. There is a need to take a holistic approach to the management of the watershed; one based on understanding the challenges both parties face, and the development of mutually beneficial solutions.

Based on the lessons learned from the actions taken somewhat independently by each major stakeholder, the following immediate actions are recommended:

1. Open the wetland's connection to the sea in a manner that does not significantly impact nearby beach goers. To achieve this the swamp may serve as a temporary fresh water reservoir that releases its water gradually at set times to the sea. This would minimize negative impact and allow the wetland to maintain an acceptable level of water quality;
2. Find an alternative emergency effluent discharge location; and
3. Develop an integrated master plan for the wetland with the aim of maintaining its health and maximising its economic value. This would require the mutual confidence between stakeholders which may be achieved by open and transparent discussions.

6 Contact Details

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Mr. Lashley is a civil engineer, professional project manager and associate in environmental planning and design. More importantly, he is a concerned Barbadian citizen who not only sees the benefit of the Graeme Hall ecosystem to the country but also understands the challenges faced in maintaining such a wetland with the conflicting (but necessary) surrounding land use practices. Mr. Lashley is currently pursuing a master's degree in Coastal Engineering & Port Development at UNESCO-IHE Institute for Water Education with the aim of using the knowledge he acquires to find sustainable solutions to this and other issues surrounding the coast of Barbados.

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