

Using GIS to Support Stormwater Management in The Bahamas

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Stormwater Management in Nassau, The Bahamas: Assessment of Current Strategies and Recommendations for the Future

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Project Purpose

Stormwater pollution is recognized as one of the most significant sources of pollution in coastal waters (NRDC, 1999). Stormwater runoff occurs every time it rains as water runs across land, picking up contaminants that result from varied land uses. These include agricultural fields, residential developments, roads, parking lots, roof tops, golf courses and urban areas. Most population centers are located along coastal waterways, exposing these natural resources to increased pollution levels and often leaving them highly degraded. Although stormwater systems have been developed to help address the problem of the quantity of water flowing over the land surface, untreated stormwater is still frequently discharged into the nearest body of water (NRDC, 1999).

Stormwater management is essential in Nassau, New Providence, and in Caribbean island states as a whole, as their economies are closely tied to the environmental and ecological integrity of the coastal zone. Unmanaged stormwater runoff can lead to significant environmental degradation, which in turn can have negative social and economic implications.

The objective of this study was to complete an integrated stormwater management assessment of Nassau Harbor, New Providence, establishing the current extent of management and potential capacities for future management. This study attempts to answer the following questions:

- How does the success of regulatory strategies or lack thereof, impact the success of stormwater management and coastal environmental quality?
- To what extent does the lack of successful regulatory strategies provide opportunity for the development of non-regulatory strategies in managing stormwater in The Bahamas?

GIS Component:

The use of GIS analysis and mapping was essential to forming recommendations regarding stormwater management in Nassau.

- Parcels were digitized and topology was verified to ensure spatial connectivity.
- A geodatabase was created for field data and modeling results for spatial interpretation.
- Pollutant loading heat maps were output to visually demonstrate loading results.

Future GIS modeling Possibilities:

- Digitalize land use layer using Feature Analyst.
- Hydrologic modeling of surface runoff.

RECOMMENDATIONS

Building government capacity for stormwater management:

- Department of the Environment
- Memorandum of Understanding (MOU) and committee among agencies involved in stormwater management
- International conventions
- Stormwater Utility

Parking lot island bioretention System
Source: NEMO, 2008, p.1



Non-regulatory structural stormwater strategies

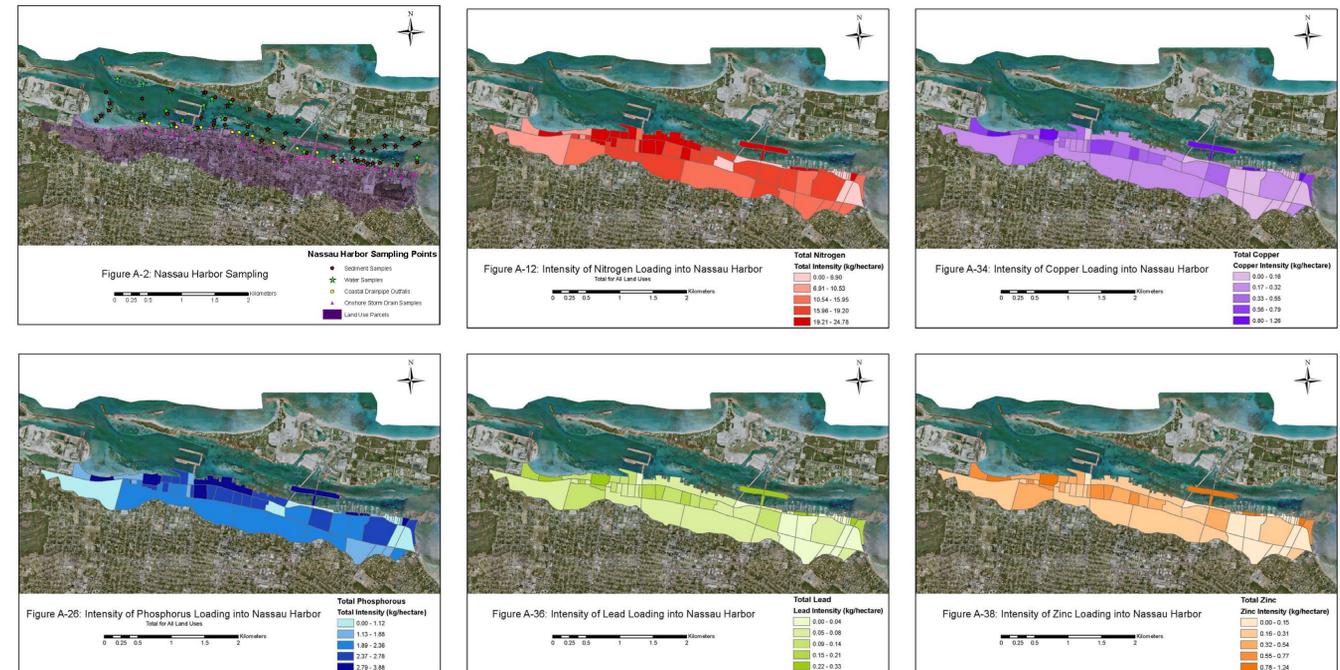
- Bioretention retrofits in parking lots
- High performance landscaping techniques, such as bioretention systems (rain gardens) and vegetated/grass swales
- Rain barrels and cisterns for rooftop runoff capture and reuse

Non-regulatory nonstructural stormwater strategies

- Water quality monitoring
- Adopt-a-beach & Adopt-a-roadway
- Education and Outreach Campaign (workshops, media advertisements, mailed flyers)
- Incorporating stormwater into the curriculum



Sampling Map and Modeled Pollutant Loading Maps



Sampling Map
Water quality monitoring data are linked to digital map in order to provide a spatial database. Laboratory results will be included as well.

Pollutant Loading Maps
The loading from Nutrients (nitrogen and phosphorous) and Metals (Lead, Copper and Zinc) were mapped to determine the parcels that are

GIS Modeling & Overall Lessons Learned

Data collection and utilization

- Required a significant amount of time and effort
- Important data was either unavailable or unattainable
- Agencies did not share data amongst themselves**
- Lack of metadata made it difficult to interpret raw data
- High resolution of aerial imagery made it difficult to utilize
- Site-specific hydrogeologic conditions in the Bahamas
- Understanding of hydrogeology required for GIS modeling
- Hydrologic modeling was challenging due to lack of streams and rivers and karst geology

Hydrologic Modeling

Why Hydrologic Modeling?

To compare "Simple Method" loading model with GIS based model and to gain a better understanding of over-land flow directions.

Challenges

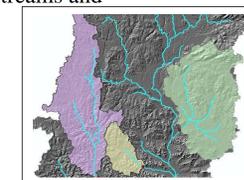
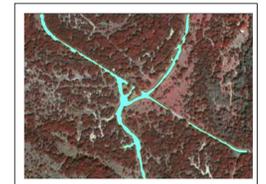
- Most models depend on streams and rivers, which The Bahamas lacks.
- Data collection and mapping effort was more time intensive than predicted, leaving less time for hydrologic modeling

Feature Analyst

What is Feature Analyst?

A program that been integrated into ArcGIS as an extension to provide a complete tool-set for extracting features of interest from imagery and scanned maps.

Extraction of Roads



Hydrologic modeling of areas with streams and rivers

Unsuccessful Extraction of Rooftops in Nassau



Why Feature Analyst?

To digitally map land uses and compare the percentages and distribution of land use with the on the ground site land use survey results.

Challenges

- High resolution of aerial imagery made it difficult for the program to extract features of interest.

References available upon request